

WEBENCH® Power Architect

Project Report

Project : 4790845/2 : PA_Project_504 (modified from 501)

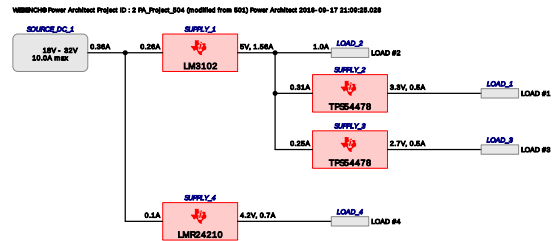
Created : 2016-09-17 21:09:25.028

Optimize project optFactor=5

Project Summary

1. Total System Efficiency	93.979 %
2. Total System BOM Count	62.0
3. Total System Footprint	2.729 kmm2
4. Total System BOM Cost	\$14.63
5. Total System Power Dissipation	700.9 mW

--> Launch WEBENCH Power Architect.



Sequencer Flag Table

Supply	Sequencer Flag	Load	Load Name
SUPPLY_1	0	LOAD_2	LOAD #2
SUPPLY_2	0	LOAD_1	LOAD #1
SUPPLY_3	0	LOAD_3	LOAD #3
SUPPLY_4	0	LOAD_4	LOAD #4

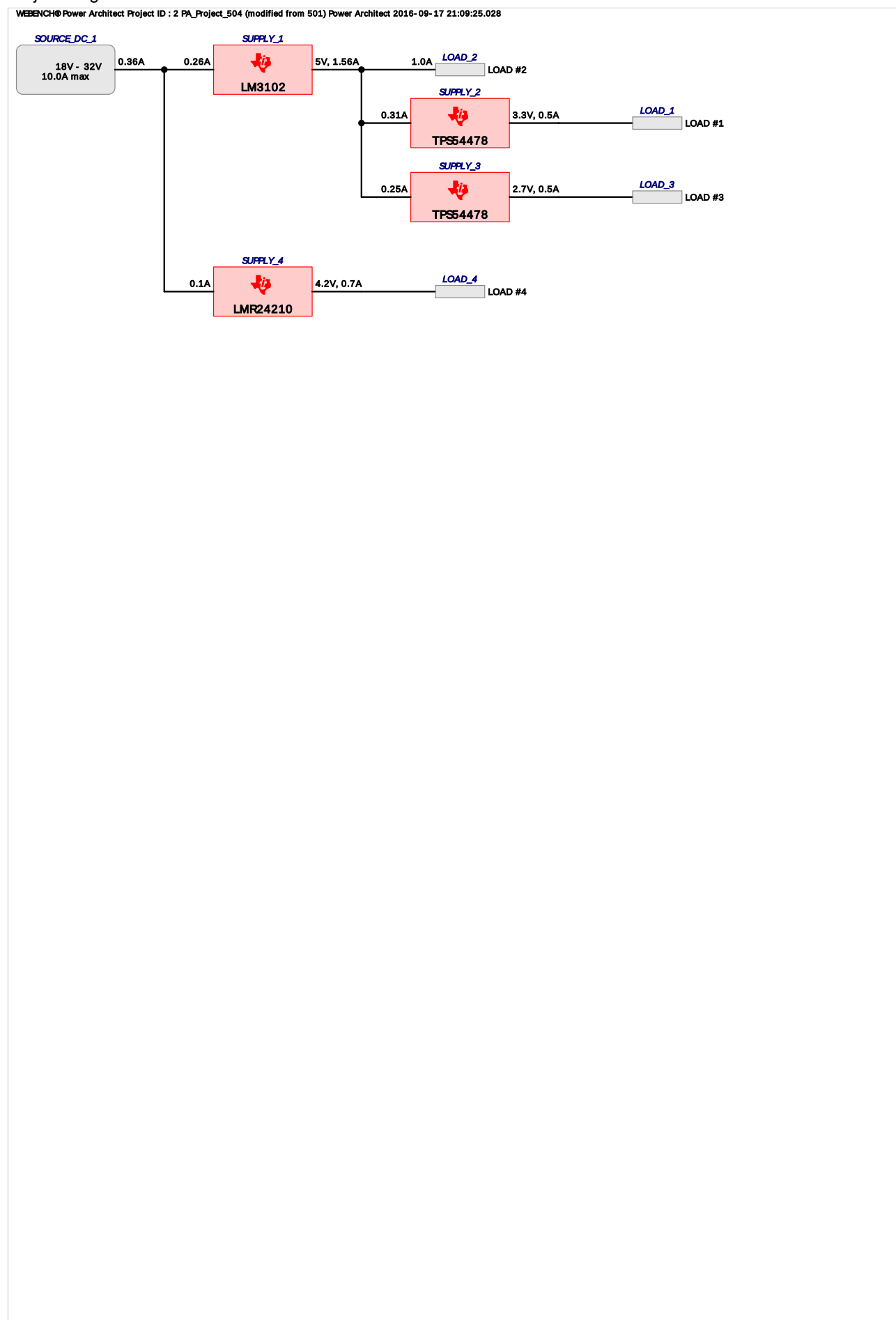
Power Supplies

#	Name	NSID	Description	Vout	Iout	Efficiency	Foot-print	Cost	Design	Page
1.	SUPPLY_1	LM3102	Switcher : High Efficiency	5 V	1.557 A	94.5%	1098	\$4.14	11	10
2.	SUPPLY_2	TPS54478	Switcher : 2.95V - 6 input, 4A output, synchronous step down converter	3.3 V	0.5 A	98.1%	332	\$3.61	9	22
3.	SUPPLY_3	TPS54478	Switcher : 2.95V - 6 input, 4A output, synchronous step down converter	2.7 V	0.5 A	97.7%	319	\$3.51	10	4
4.	SUPPLY_4	LMR24210	Switcher : High Efficiency	4.2 V	0.7 A	94.2%	980	\$3.37	12	16

Power Loads

#	Name	VLoad	ILoad	Description
1.	LOAD #2	5 V	1 A	VoutRipple=10%
2.	LOAD #1	3.3 V	0.5 A	VoutRipple=10%
3.	LOAD #3	2.7 V	0.5 A	VoutRipple=10%
4.	LOAD #4	4.2 V	0.7 A	VoutRipple=10%

Project Diagram



Electrical Procurement BOM

Manufacturer	Part Number	Description	Quantity	Budgetary Price	Footprint (mm ²)
Panasonic	16SVPE180M	CAPSMT_62_C10	1	\$0.49	74
Kemet	C0805C104K5RACTU	0805	2	\$0.01	14
Vishay-Dale	CRCW0402100KFKED	0402	2	\$0.01	6
Vishay-Dale	CRCW0402107KFKED	0402	2	\$0.01	6
Vishay-Dale	CRCW04021K00FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW040220K0FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW0402221KFKED	0402	2	\$0.01	6
Vishay-Dale	CRCW0402249RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402357KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402432KFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04024K22FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW04024K42FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040251K1FKED	0402	2	\$0.01	6
Vishay-Dale	CRCW04025K23FKED	0402	1	\$0.01	3
Vishay-Dale	CRCW0402634RFKED	0402	1	\$0.01	3
Vishay-Dale	CRCW040282K5FKED	0402	2	\$0.01	6
MuRata	GRM033C80J223KE01D	0201	1	\$0.01	2
MuRata	GRM033R60J103KA01D	0201	1	\$0.01	2
MuRata	GRM033R61A332KA01D	0201	2	\$0.01	4
MuRata	GRM033R61A472KA01D	0201	1	\$0.01	2
MuRata	GRM155C80J124KE01D	0402	1	\$0.02	3
MuRata	GRM155R61A104KA01D	0402	2	\$0.01	6
MuRata	GRM155R61A563KA01D	0402	1	\$0.01	3
MuRata	GRM155R61C104KA88D	0402	2	\$0.01	6
MuRata	GRM155R71E103KA01D	0402	1	\$0.01	3
MuRata	GRM155R71E153KA61D	0402	1	\$0.01	3
MuRata	GRM155R71E333KA88D	0402	2	\$0.01	6
MuRata	GRM188R61E105KA12D	0603	2	\$0.01	9
MuRata	GRM31CC80J476KE18L	1206_190	1	\$0.10	11
MuRata	GRM31CE70G476ME15L	1206_190	1	\$0.10	11
MuRata	GRM31CR60J107ME39L	1206_190	1	\$0.14	11
MuRata	GRM31CR61A226ME19L	1206_190	1	\$0.08	11
MuRata	GRM31CR71H475KA12L	1206	6	\$0.07	22
MuRata	GRM32ER61C226ME20L	1210	2	\$0.12	15
Texas Instruments	LM3102MHX/NOPB	MXA20A	1	\$2.15	71
Texas Instruments	LMR24210TL/NOPB	TLC28VFA	1	\$1.73	16
Bourns	PM2110-221K-RC	PM2110	1	\$1.21	890
Bourns	PM2110-820K-RC	PM2110	1	\$1.21	890
Yageo America	RT0805BRD075K69L	0805	1	\$0.05	7
Coilcraft	SER1390-473MLB	SER1390	2	\$0.95	480
Texas Instruments	TPS54478RTER	S-PWQFN-N16	2	\$2.20	34
Total			62	\$12673.5487070000004	

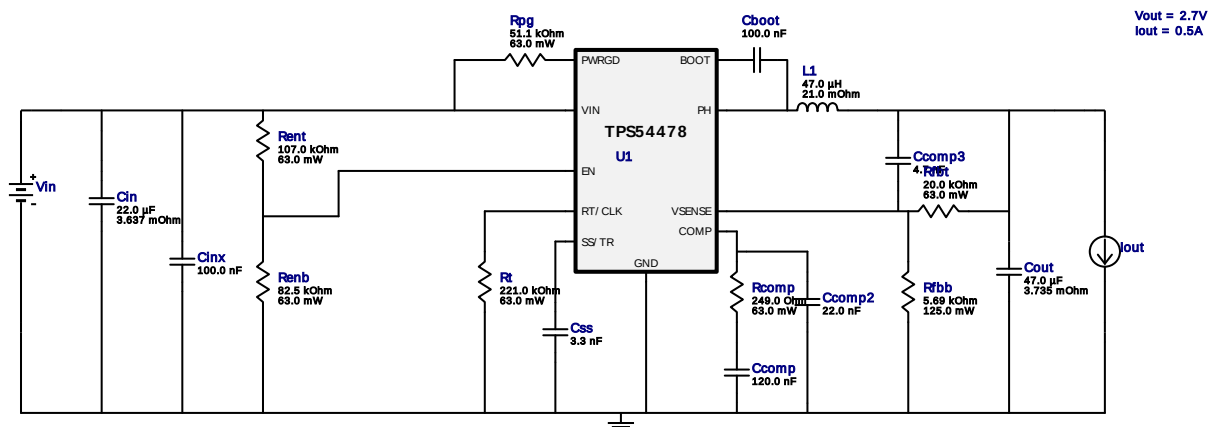


Vout = 2.7V
Iout = 0.5A

Device = TPS54478RTER
Topology = Buck
Created = 9/17/16 9:09:23 PM
BOM Cost = \$3.51
BOM Count = 17
Total Pd = 0.03W

WEBENCH® Design Report

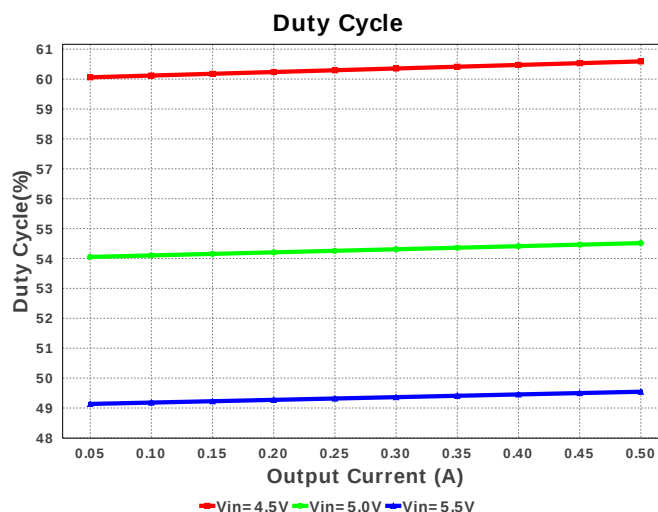
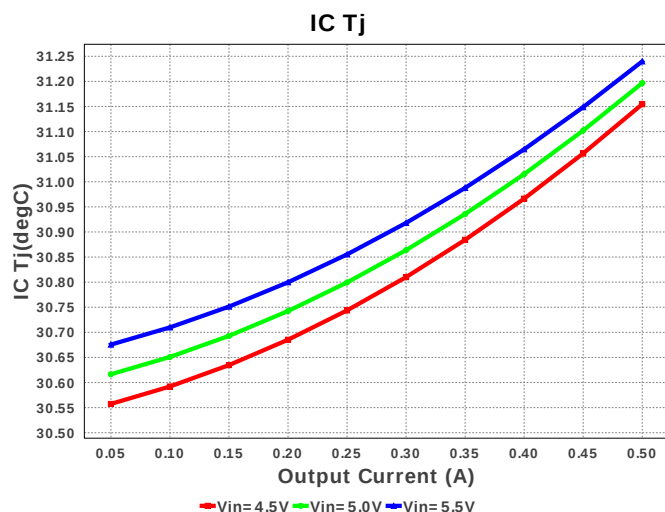
Design : 4790845/10 TPS54478RTER
TPS54478RTER 4.5V-5.5V to 2.70V @ 0.5A



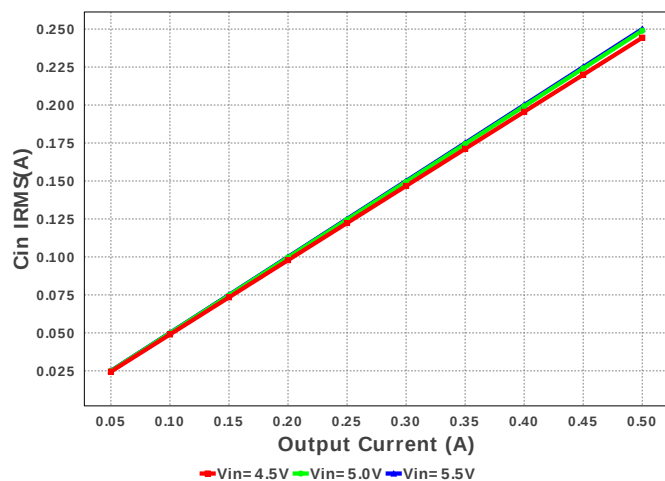
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Ccomp	MuRata	GRM155C80J124KE01D Series= X6S	Cap= 120.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.02	0402 3 mm ²
3.	Ccomp2	MuRata	GRM033C80J223KE01D Series= X6S	Cap= 22.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
4.	Ccomp3	MuRata	GRM033R61A472KA01D Series= X5R	Cap= 4.7 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
5.	Cin	MuRata	GRM31CR61A226ME19L Series= X5R	Cap= 22.0 uF ESR= 3.637 mOhm VDC= 10.0 V IRMS= 3.56456 A	1	\$0.08	1206_190 11 mm ²
6.	Cinx	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
7.	Cout	MuRata	GRM31CE70G476ME15L Series= X7U	Cap= 47.0 uF ESR= 3.735 mOhm VDC= 4.0 V IRMS= 4.1841 A	1	\$0.10	1206_190 11 mm ²
8.	Css	MuRata	GRM033R61A332KA01D Series= X5R	Cap= 3.3 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
9.	L1	Coilcraft	SER1390-473MLB	L= 47.0 µH DCR= 21.0 mOhm	1	\$0.95	SER1390 240 mm ²

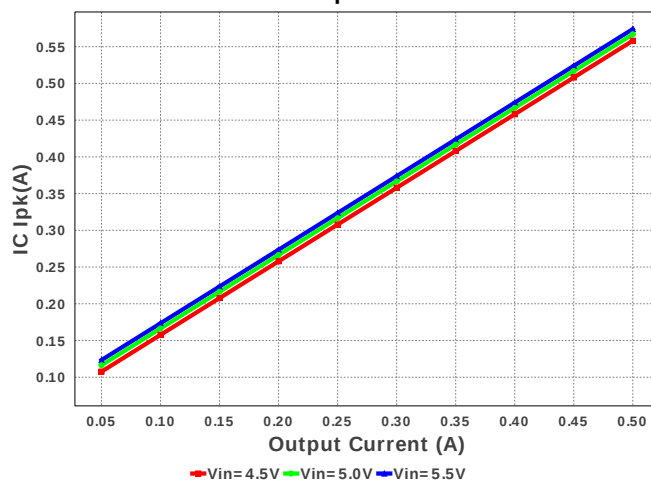
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Rcomp	Vishay-Dale	CRCW0402249RFKED Series= CRCW..e3	Res= 249.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
11.	Renb	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
12.	Rent	Vishay-Dale	CRCW0402107KFKED Series= CRCW..e3	Res= 107.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
13.	Rfbb	Yageo America	RT0805BRD075K69L Series= RT0805	Res= 5.69 kOhm Power= 125.0 mW Tolerance= 0.1%	1	\$0.05	0805 7 mm ²
14.	Rfbt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
15.	Rpg	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
16.	Rt	Vishay-Dale	CRCW0402221KFKED Series= CRCW..e3	Res= 221.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
17.	U1	Texas Instruments	TPS54478RTER	Switcher	1	\$2.20	S-PWQFN-N16 17 mm ²



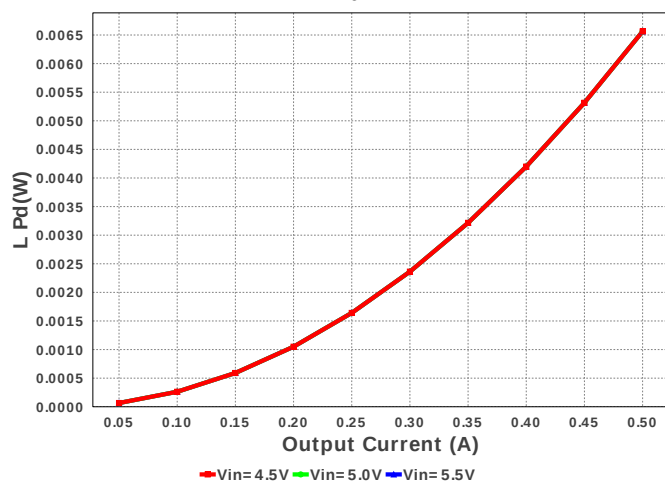
Cin IRMS



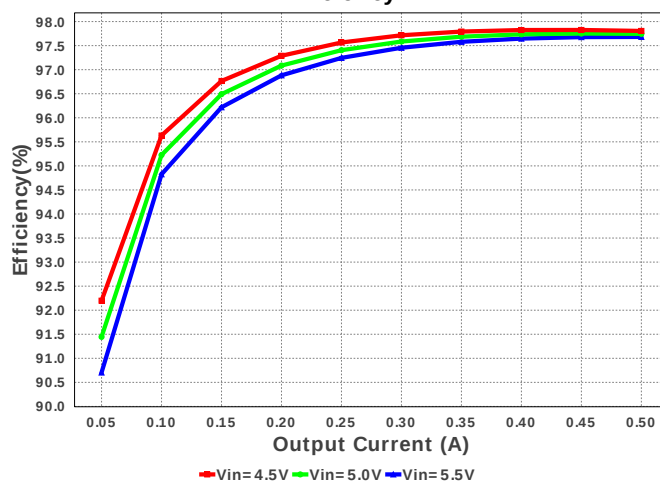
IC Ipk



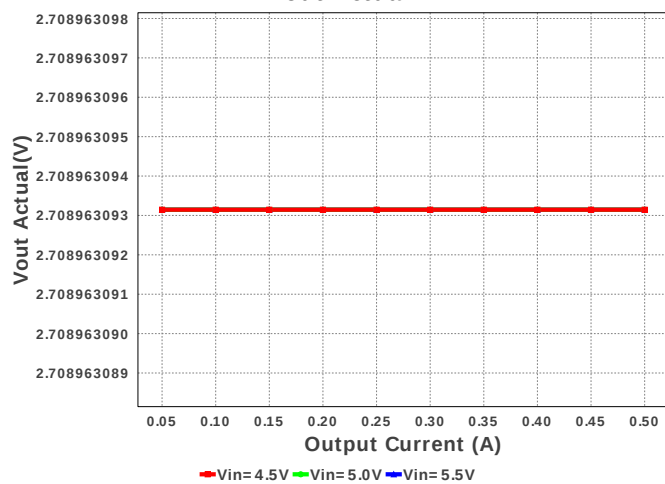
L Pd



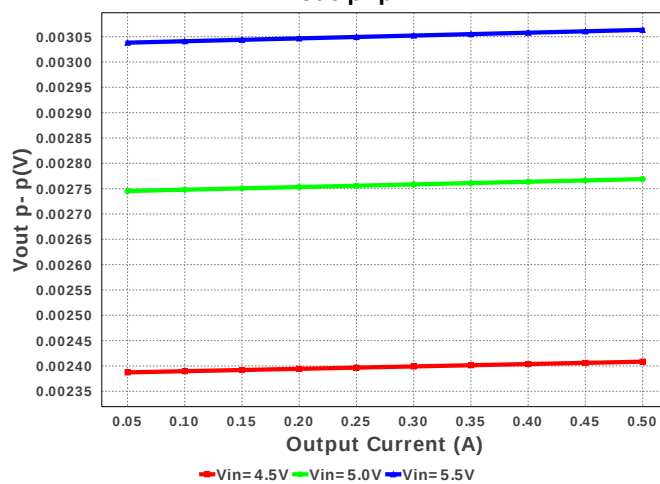
Efficiency

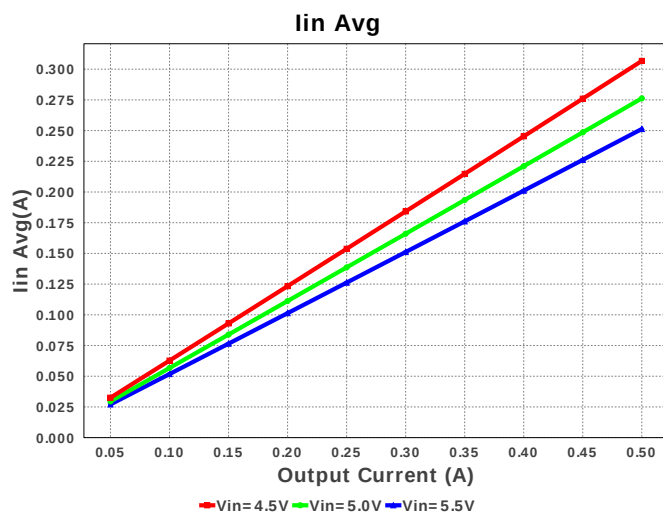
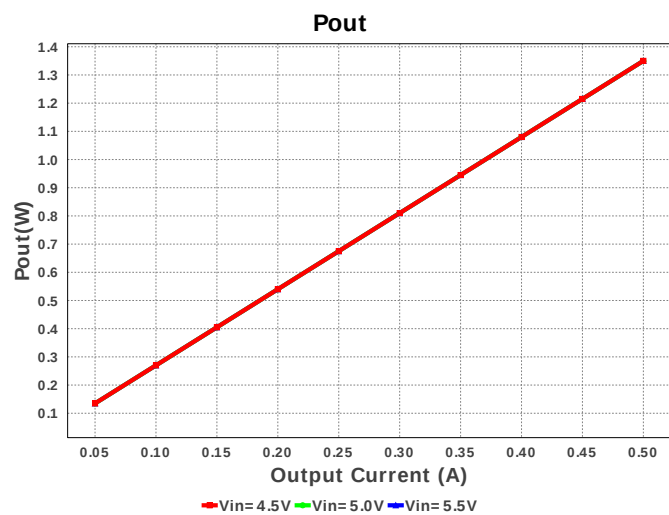
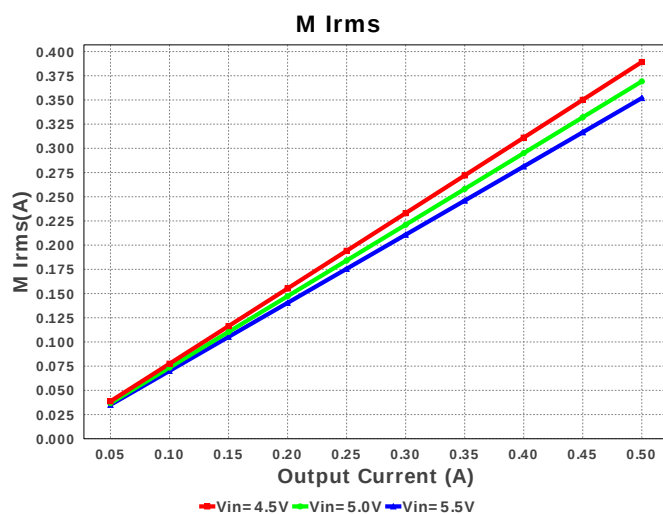
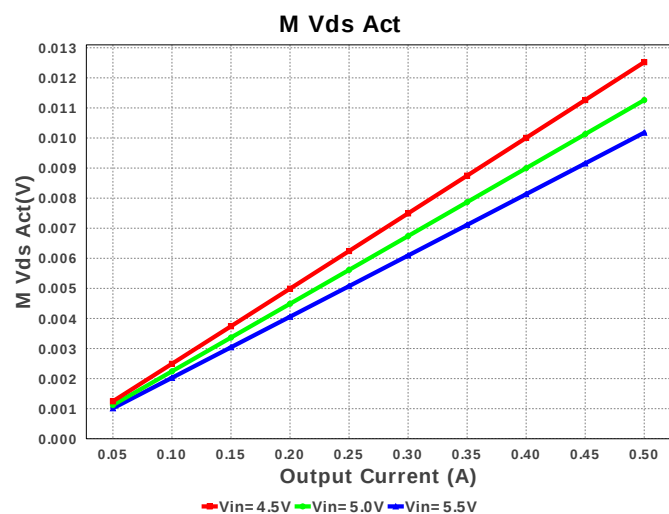
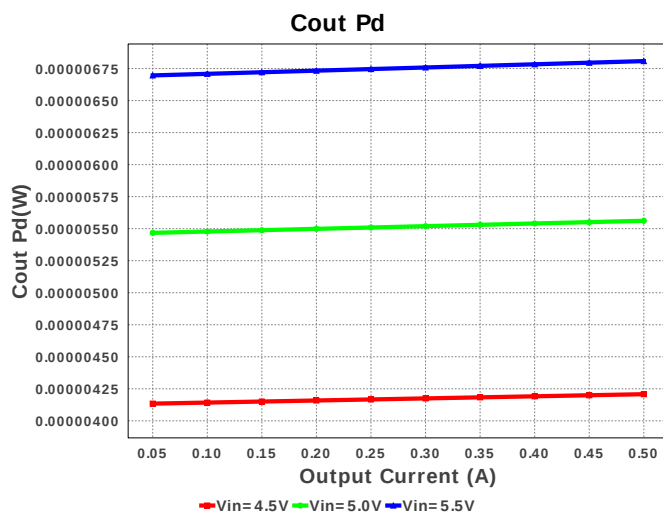
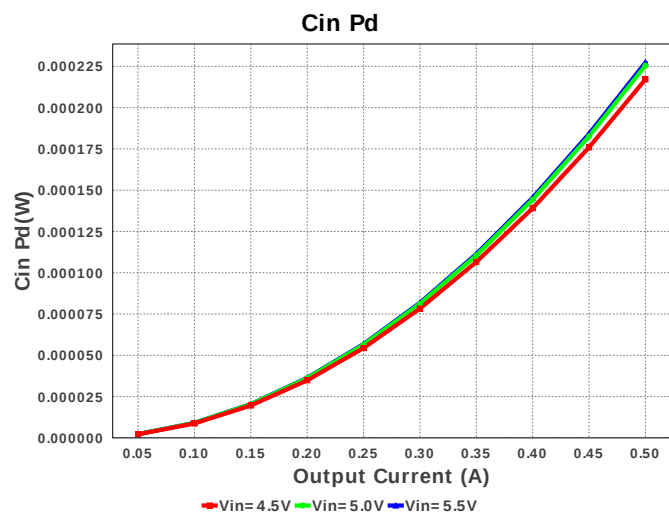


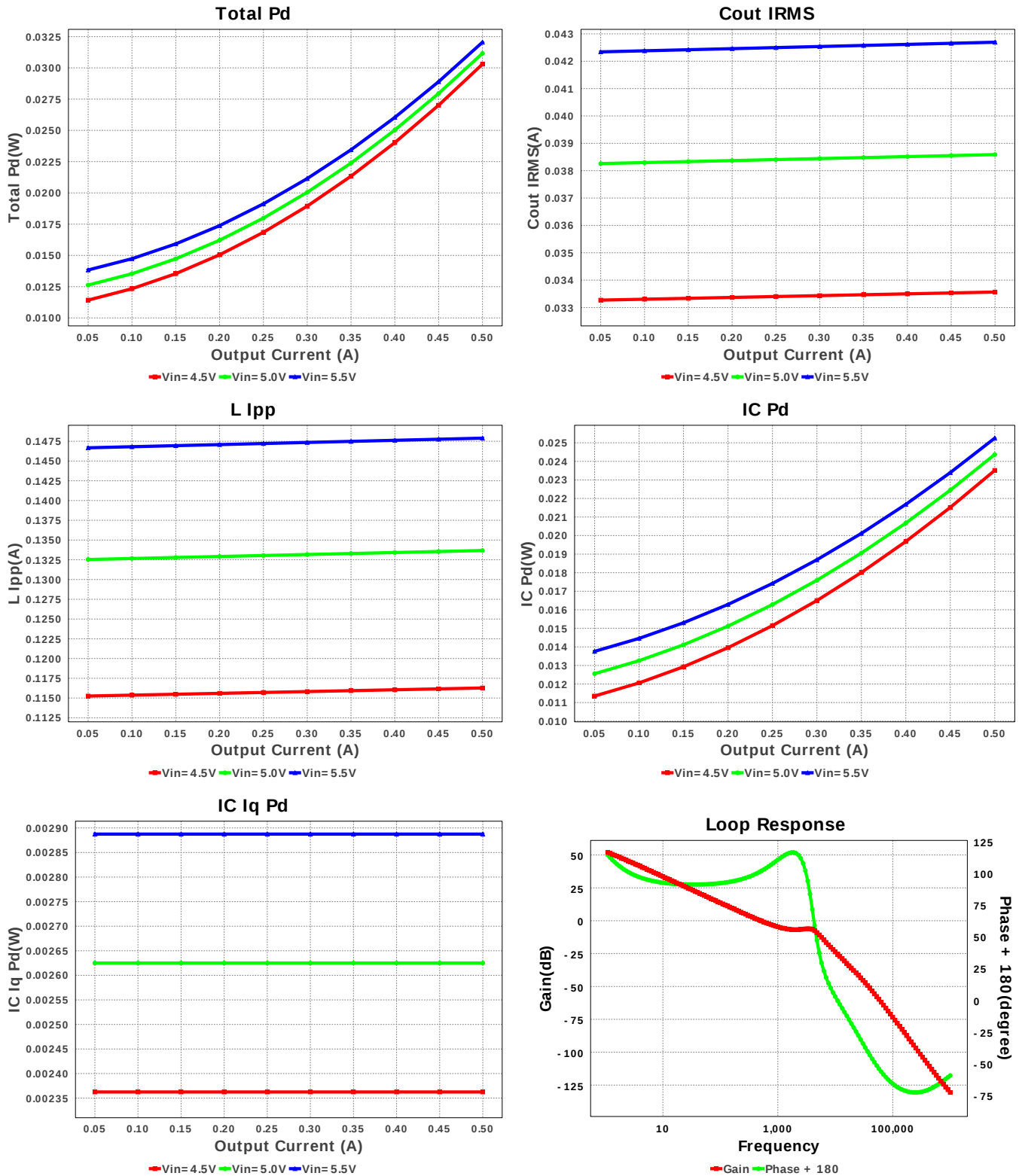
Vout Actual



Vout p-p







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	249.99 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	42.694 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	573.947 mA	Current	Peak switch current in IC
4.	Iin Avg	251.28 mA	Current	Average input current
5.	L Ipp	147.89 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	351.94 mA	Current	MOSFET RMS current
7.	BOM Count	17	General	Total Design BOM count
8.	FootPrint	319.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	199.574 kHz	General	Switching frequency
10.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	10.178 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	1.35 W	General	Total output power
14.	Total BOM	\$3.51	General	Total BOM Cost
15.	Vout Actual	2.709 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	2.7 V	Op_Point	Operational Output Voltage
17.	Cross Freq	507.395 Hz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	49.545 %	Op_point	Duty cycle
19.	Efficiency	97.681 %	Op_point	Steady state efficiency
20.	Gain Marg	-25.603 dB	Op_point	Bode Plot Gain Margin
21.	IC Tj	31.24 degC	Op_point	IC junction temperature
22.	ICThetaJA	49.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	500.0 mA	Op_point	Iout operating point
24.	Phase Marg	102.205 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	5.5 V	Op_point	Vin operating point
26.	Vout p-p	3.063 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	227.294 μ W	Power	Input capacitor power dissipation
28.	Cout Pd	6.808 μ W	Power	Output capacitor power dissipation
29.	IC Iq Pd	2.887 mW	Power	IC Iq Pd
30.	IC Pd	25.25 mW	Power	IC power dissipation
31.	L Pd	6.563 mW	Power	Inductor power dissipation
32.	Total Pd	32.05 mW	Power	Total Power Dissipation
33.	Vout Tolerance	2.538 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	5.5	Maximum input voltage
3.	VinMin	4.5	Minimum input voltage
4.	Vout	2.7	Output Voltage
5.	base_pn	TPS54478	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. TPS54478 Product Folder : <http://www.ti.com/product/TPS54478> : contains the data sheet and other resources.

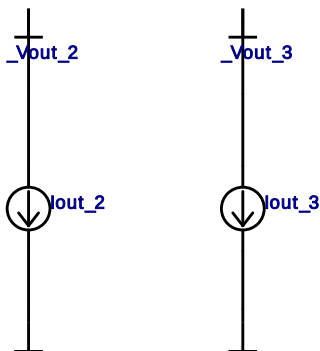
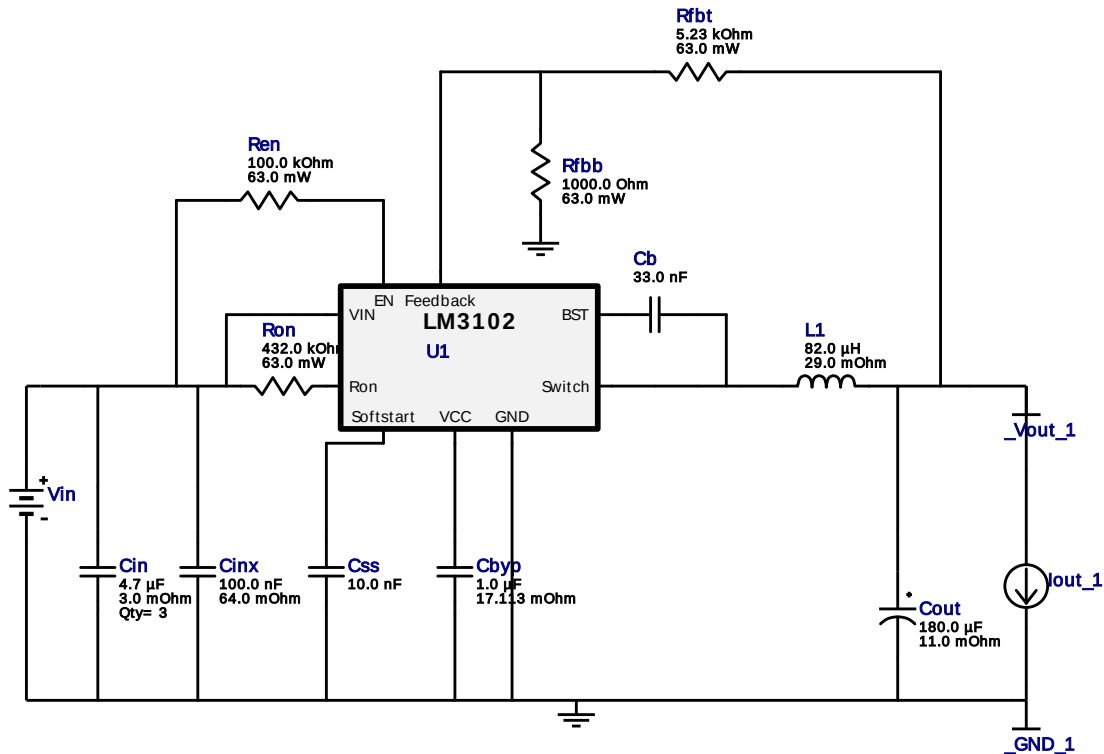


Vout = 5.0V
Iout = 1.56A

Device = LM3102MHX/NOPB
Topology = Buck
Created = 9/17/16 9:09:24 PM
BOM Cost = \$4.14
BOM Count = 14
Total Pd = 0.46W

WEBENCH® Design Report

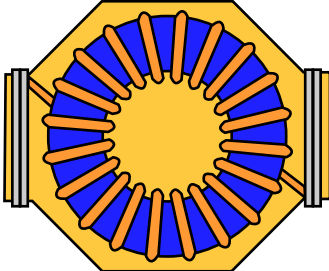
Design : 4790845/11 LM3102MHX/NOPB
LM3102MHX/NOPB 18.0V-32.0V to 5.00V @ 1.55708A

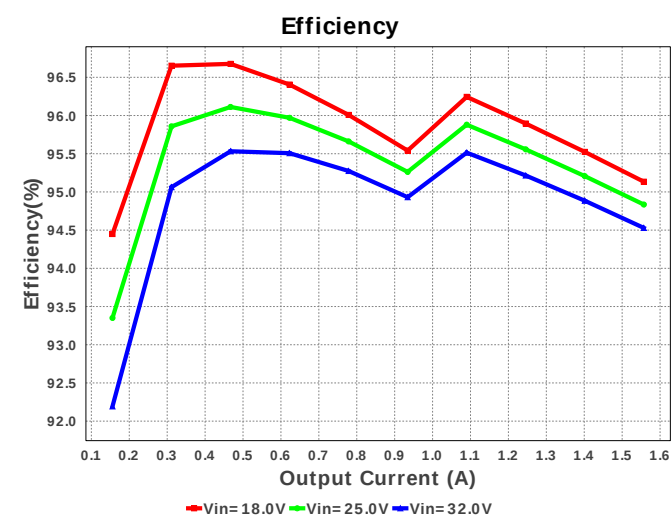
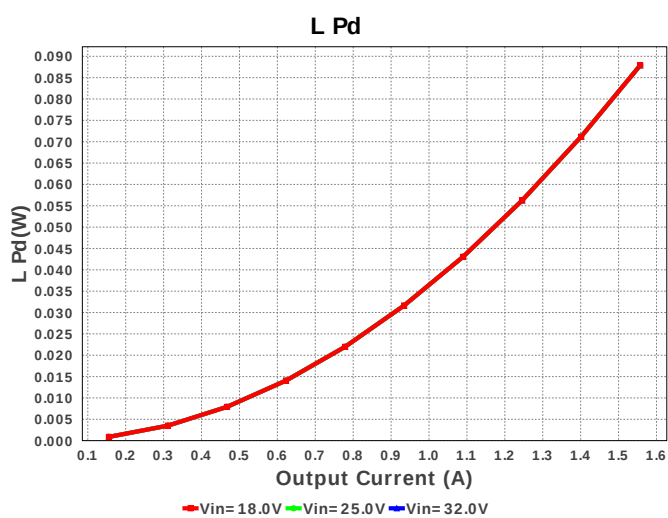
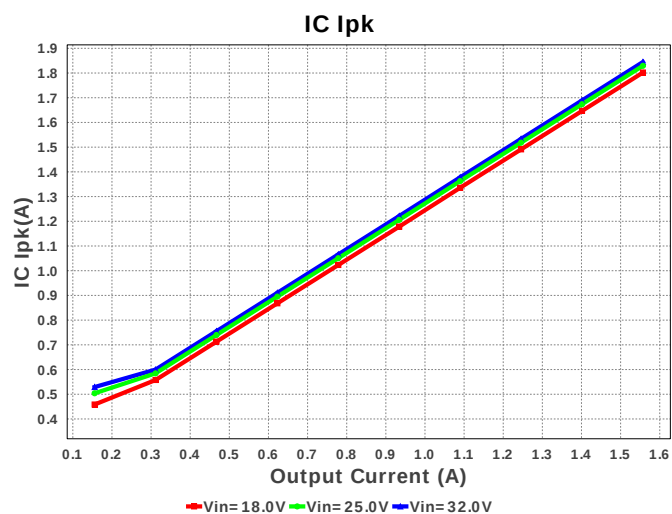
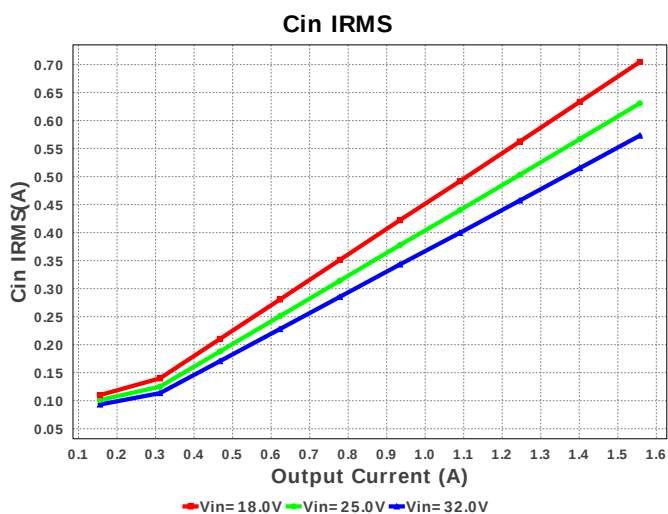
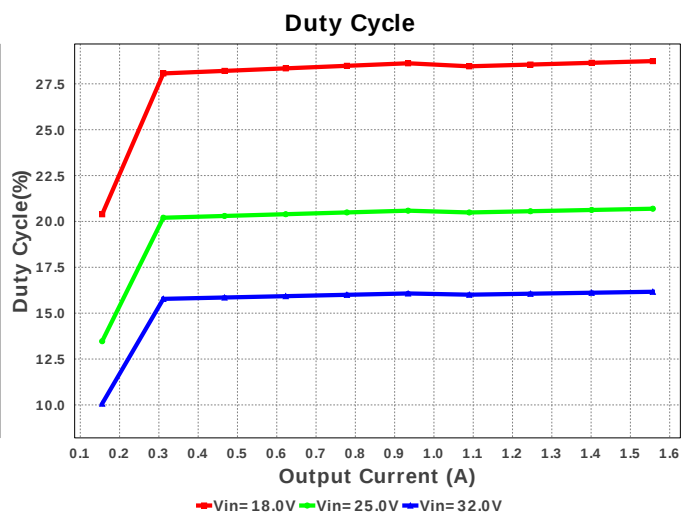
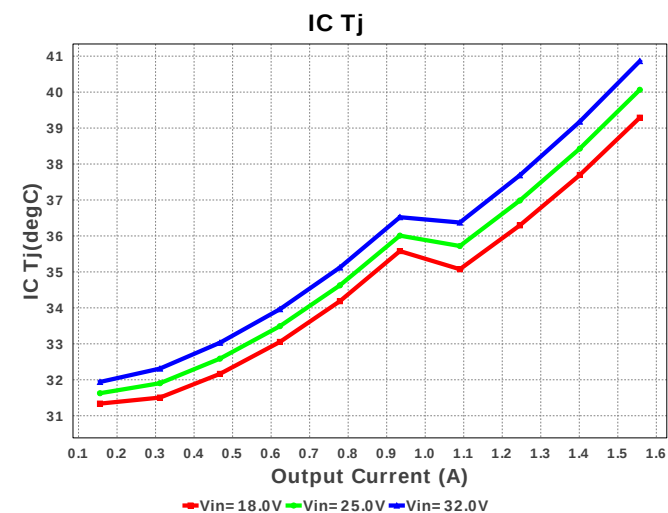


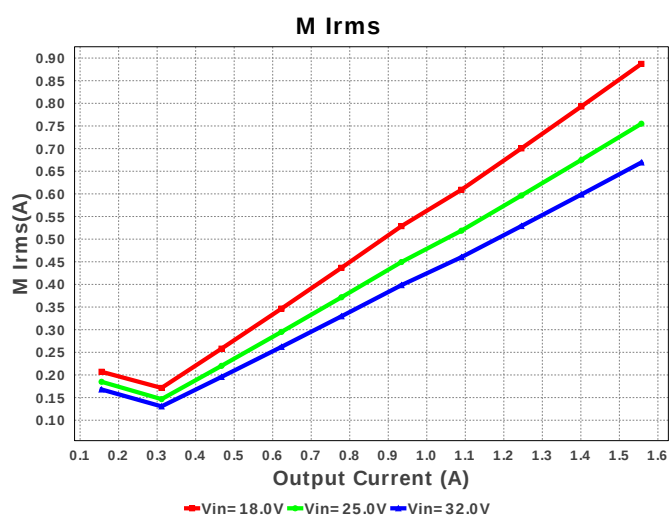
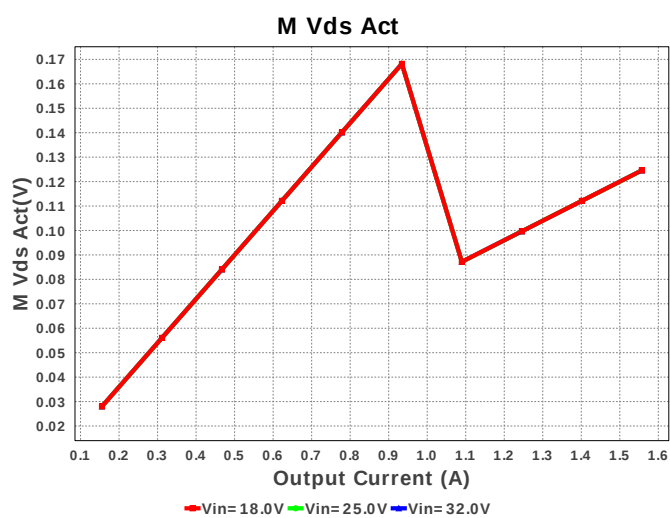
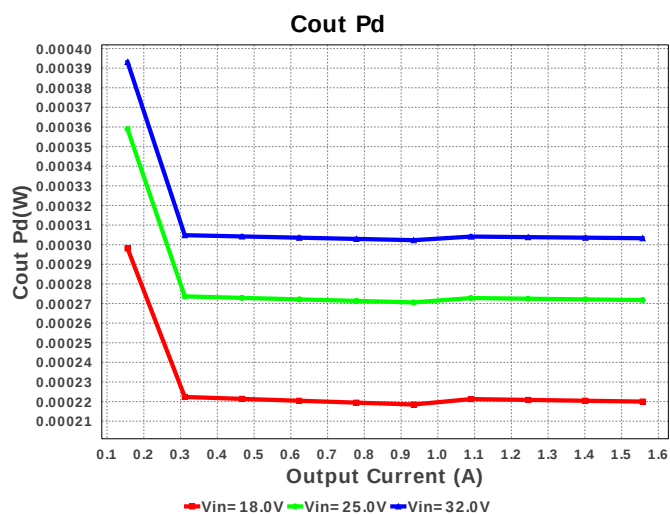
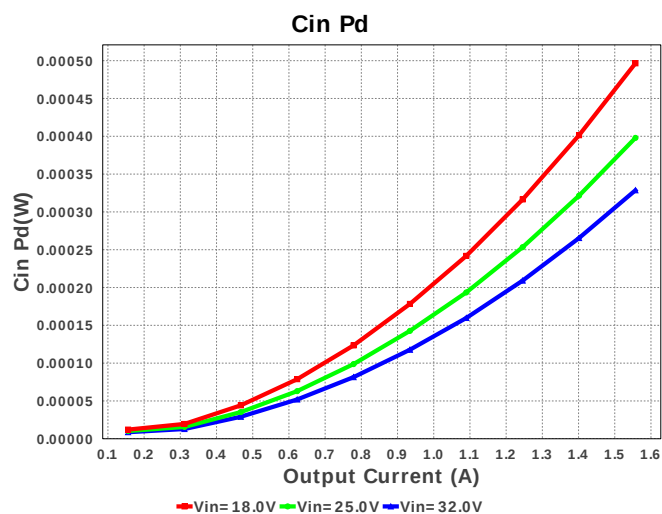
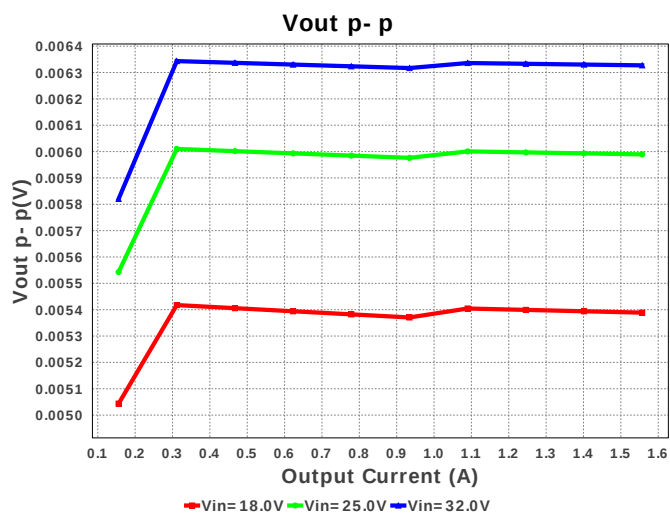
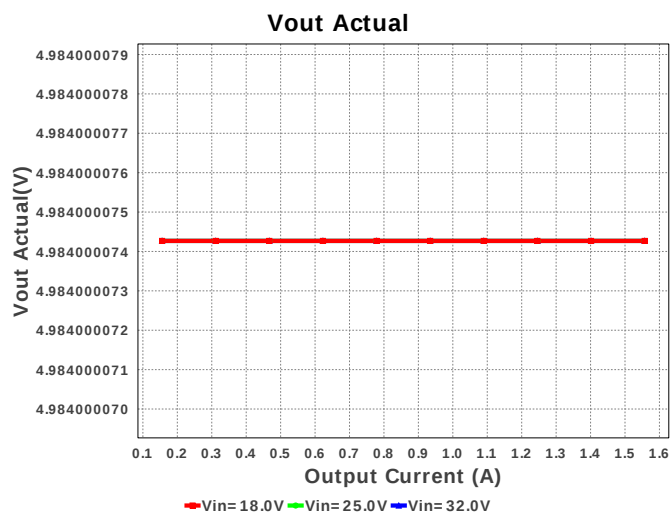
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.

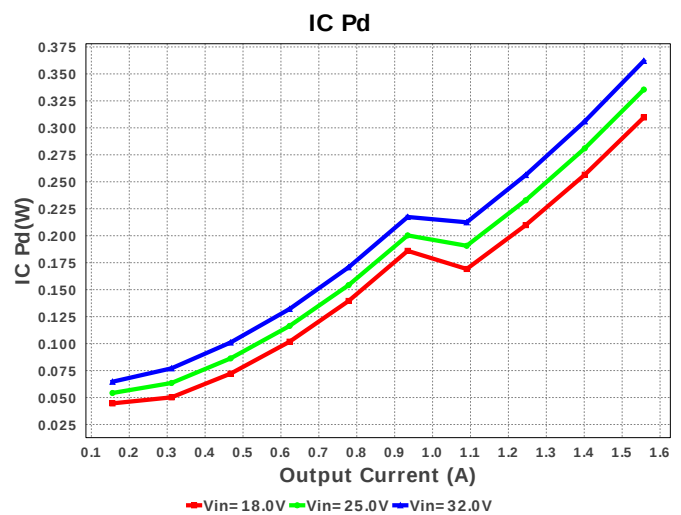
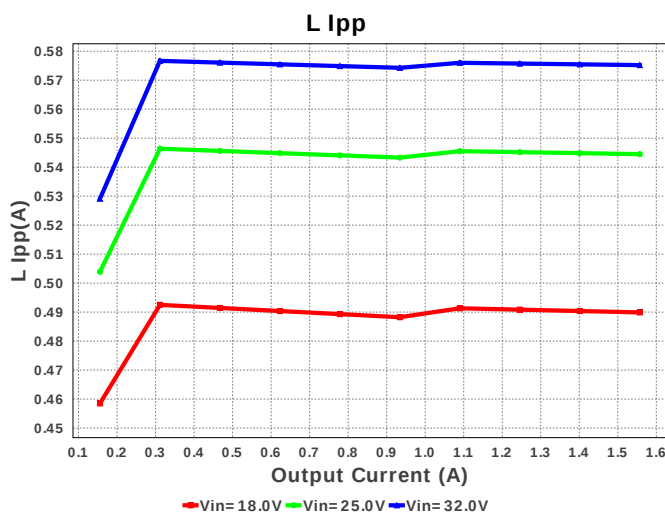
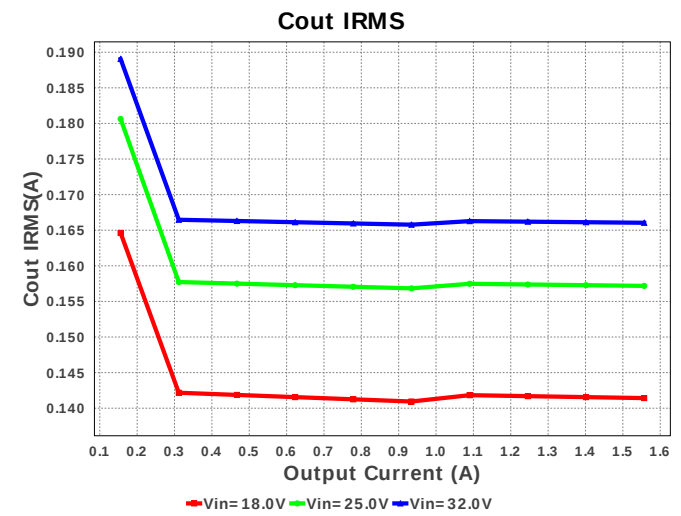
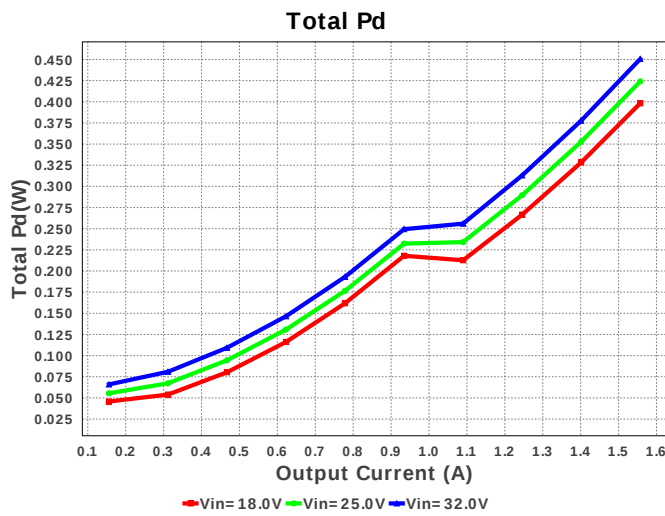
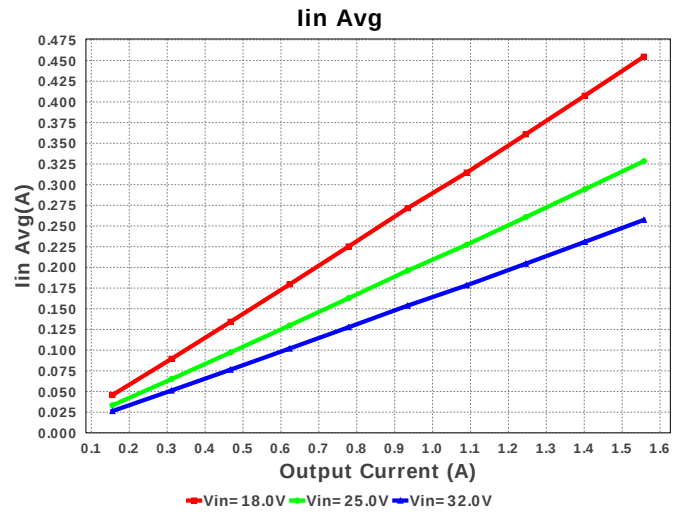
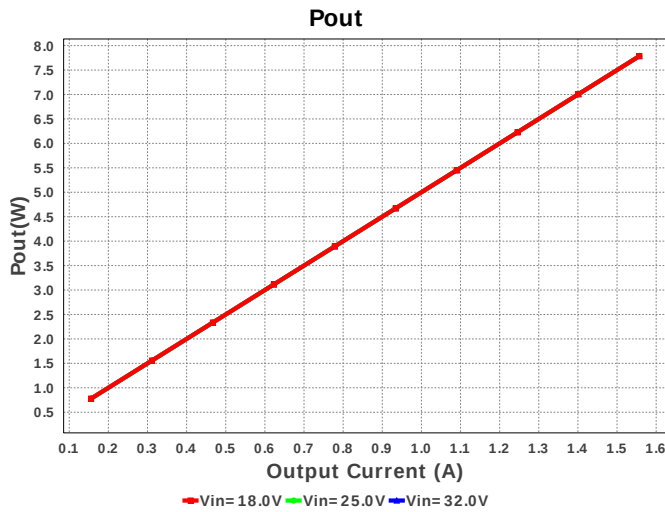
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cb	MuRata	GRM155R71E333KA88D Series= X7R	Cap= 33.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
2.	Cbyp	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	\$0.01	 0603 5 mm ²
3.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	3	\$0.07	 1206 11 mm ²
4.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	 0805 7 mm ²
5.	Cout	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	1	\$0.49	 CAPSMT_62_C10 74 mm ²
6.	Css	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
7.	L1	Bourns	PM2110-820K-RC	L= 82.0 uH DCR= 29.0 mOhm	1	\$1.21	 PM2110 890 mm ²
8.	Ren	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
9.	Rfbb	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
10.	Rfbt	Vishay-Dale	CRCW04025K23FKED Series= CRCW..e3	Res= 5.23 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
11.	Ron	Vishay-Dale	CRCW0402432KFKED Series= CRCW..e3	Res= 432.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
12.	U1	Texas Instruments	LM3102MHX/NOPB	Switcher	1	\$2.15	 MXA20A 71 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	573.234 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	166.046 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.845 A	Current	Peak switch current in IC
4.	Iin Avg	257.51 mA	Current	Average input current
5.	L Ipp	575.2 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	669.822 mA	Current	MOSFET RMS current
7.	BOM Count	14	General	Total Design BOM count
8.	FootPrint	1.098 k mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	89.031 kHz	General	Switching frequency
10.	IC Tolerance	16.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	124.566 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	7.785 W	General	Total output power
14.	Total BOM	\$4.14	General	Total BOM Cost
15.	Vout Actual	4.984 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	16.167 %	Op_point	Duty cycle
18.	Efficiency	94.478 %	Op_point	Steady state efficiency
19.	IC Tj	44.66 degC	Op_point	IC junction temperature
20.	ICThetaJA	40.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	1.557 A	Op_point	Iout operating point
22.	VIN_OP	32.0 V	Op_point	Vin operating point
23.	Vout p-p	6.327 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	328.597 μ W	Power	Input capacitor power dissipation
25.	Cout Pd	303.284 μ W	Power	Output capacitor power dissipation
26.	IC Pd	366.503 mW	Power	IC power dissipation
27.	L Pd	87.888 mW	Power	Inductor power dissipation
28.	Total Pd	455.03 mW	Power	Total Power Dissipation
29.	Vout Tolerance	3.73 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.557	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	5.0	Output Voltage
5.	base_pn	LM3102	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. LM3102 Product Folder : <http://www.ti.com/product/LM3102> : contains the data sheet and other resources.

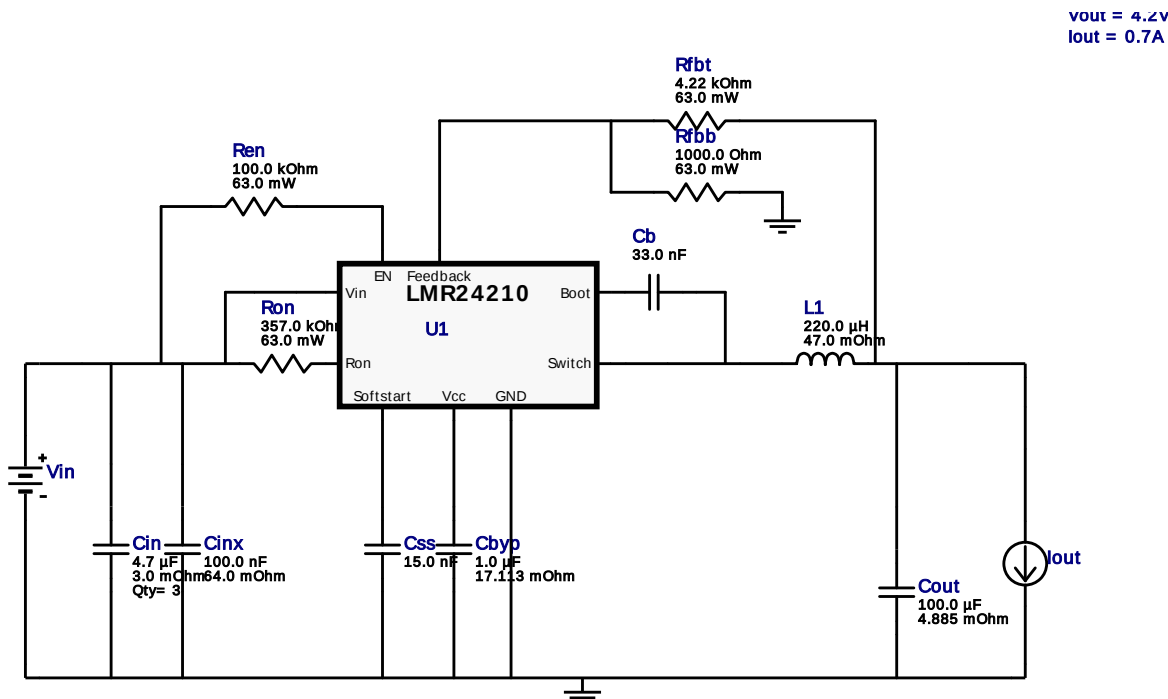


Vout = 4.2V
Iout = 0.7A

Device = LMR24210TL/NOPB
Topology = Buck
Created = 9/17/16 9:09:24 PM
BOM Cost = \$3.37
BOM Count = 14
Total Pd = 0.18W

WEBENCH® Design Report

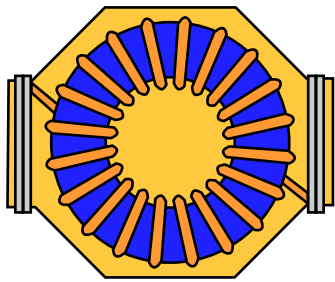
Design : 4790845/12 LMR24210TL/NOPB
LMR24210TL/NOPB 18.0V-32.0V to 4.20V @ 0.7A

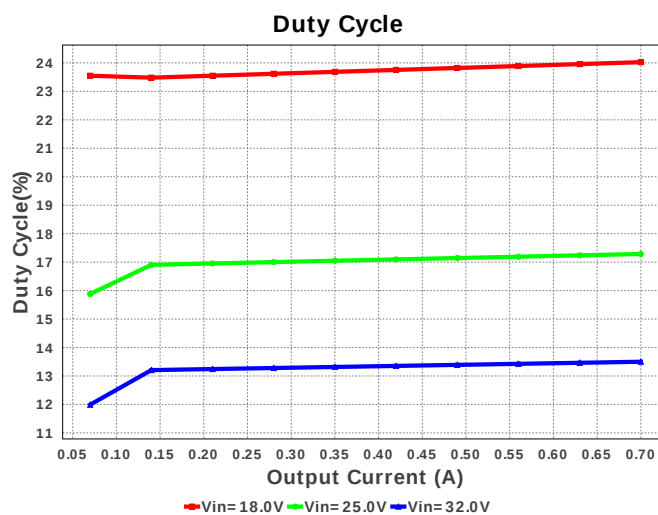
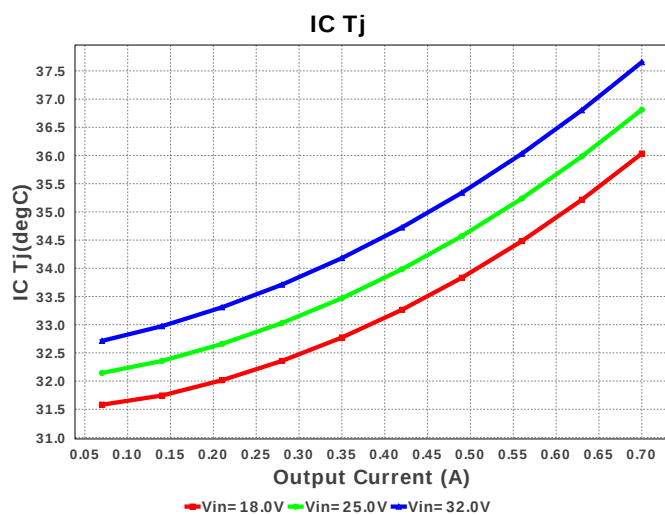


1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.

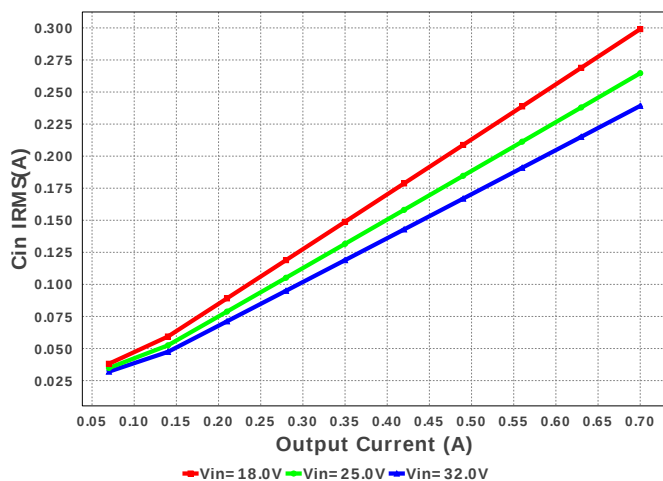
Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cb	MuRata	GRM155R71E333KA88D Series= X7R	Cap= 33.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Cbyp	MuRata	GRM188R61E105KA12D Series= X5R	Cap= 1.0 uF ESR= 17.113 mOhm VDC= 25.0 V IRMS= 979.39 mA	1	\$0.01	0603 5 mm ²
3.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	3	\$0.07	1206 11 mm ²
4.	Cinx	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	0805 7 mm ²
5.	Cout	MuRata	GRM31CR60J107ME39L Series= X5R	Cap= 100.0 uF ESR= 4.885 mOhm VDC= 6.3 V IRMS= 4.4118 A	1	\$0.14	1206_190 11 mm ²
6.	Css	MuRata	GRM155R71E153KA61D Series= X7R	Cap= 15.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²

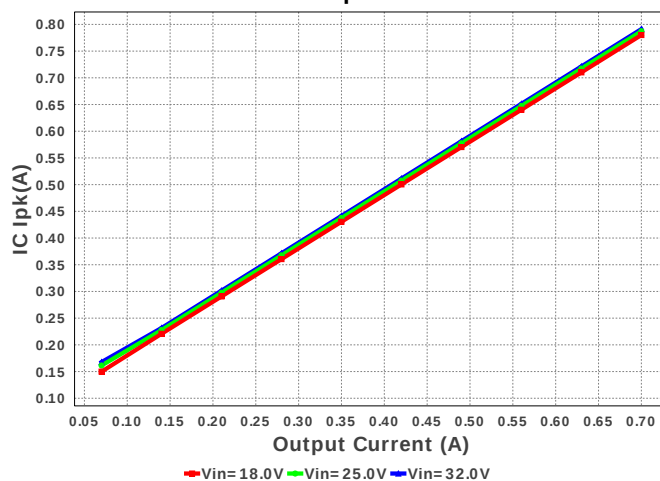
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
7.	L1	Bourns	PM2110-221K-RC	L= 220.0 μ H DCR= 47.0 mOhm	1	\$1.21	 PM2110 890 mm ²
8.	Ren	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
9.	Rfbb	Vishay-Dale	CRCW04021K00FKED Series= CRCW..e3	Res= 1000.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
10.	Rfbt	Vishay-Dale	CRCW04024K22FKED Series= CRCW..e3	Res= 4.22 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
11.	Ron	Vishay-Dale	CRCW0402357KFKED Series= CRCW..e3	Res= 357.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
12.	U1	Texas Instruments	LMR24210TL/NOPB	Switcher	1	\$1.73	 TLC28VFA 16 mm ²



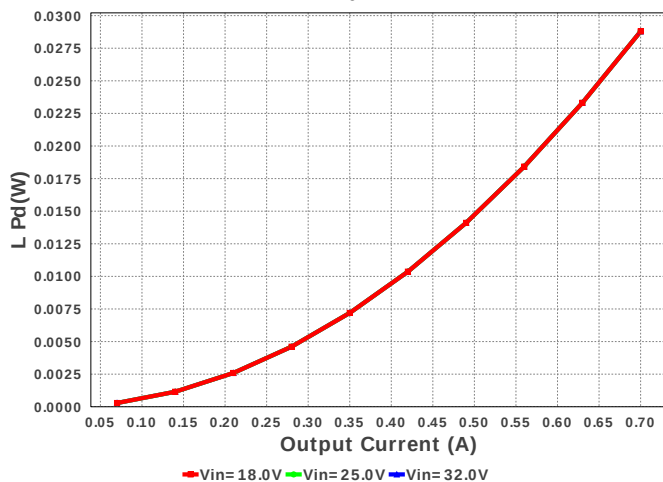
Cin IRMS



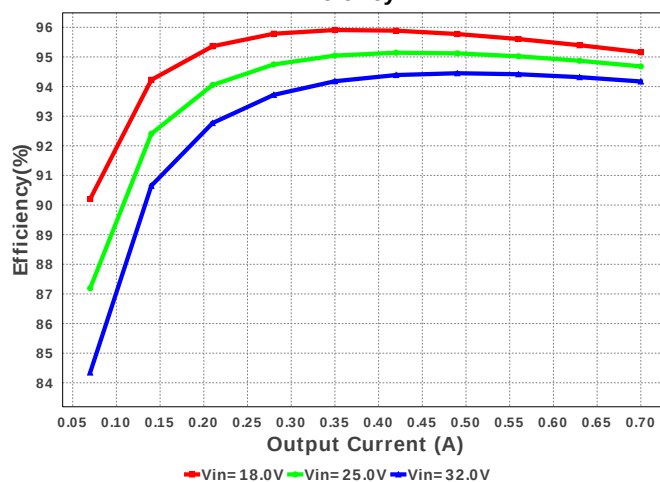
IC Ipk



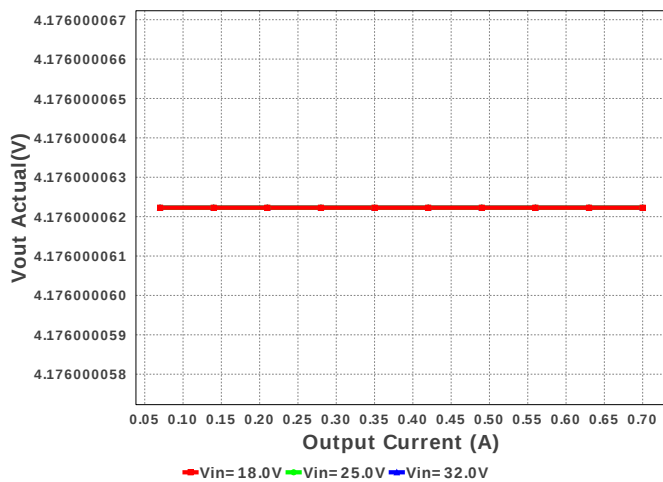
L Pd



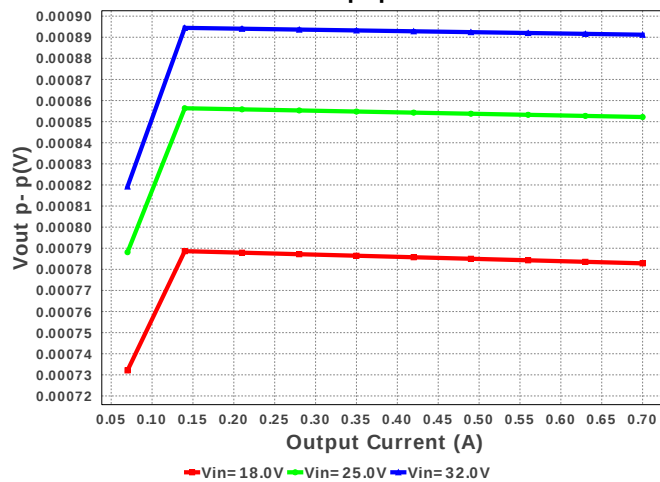
Efficiency

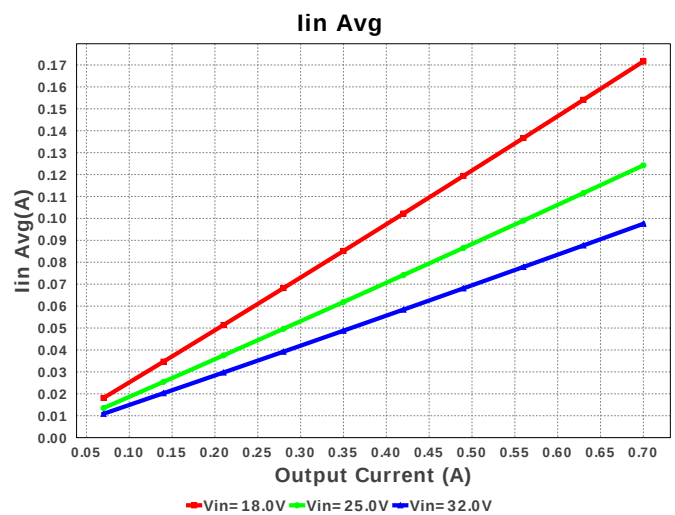
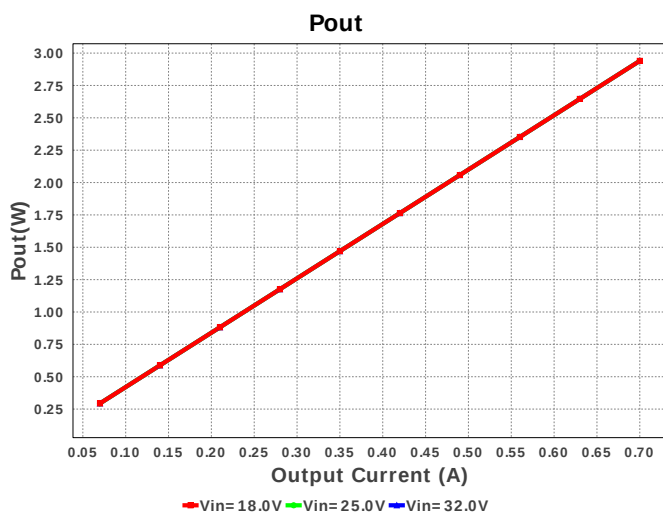
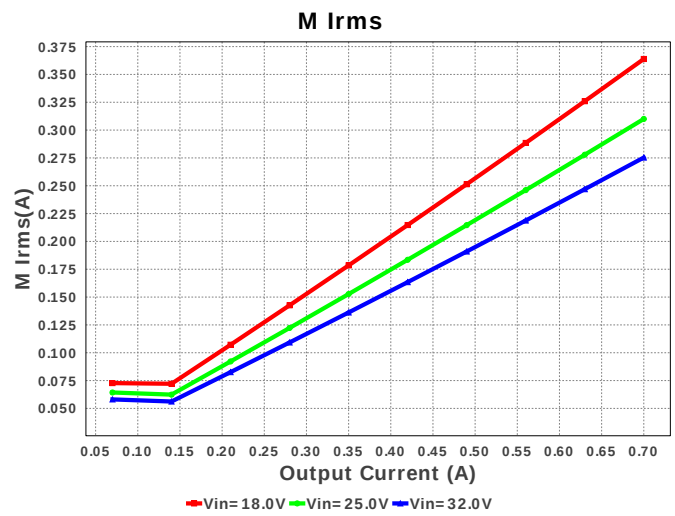
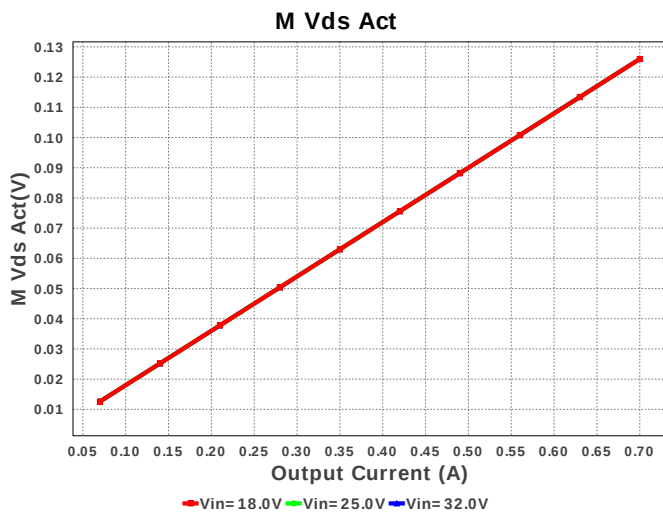
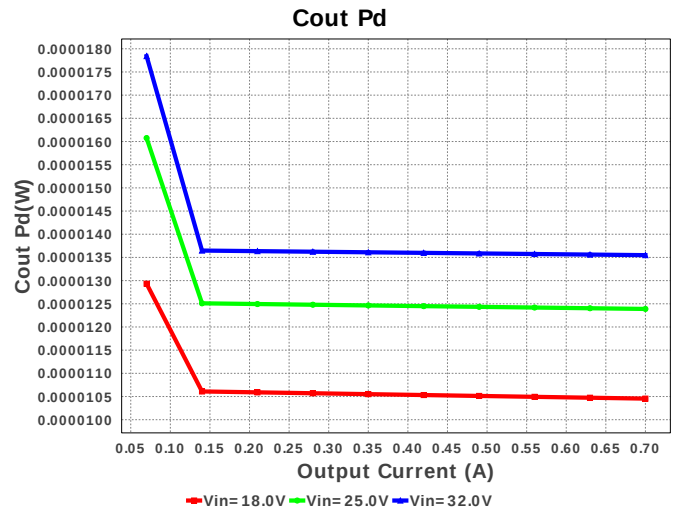
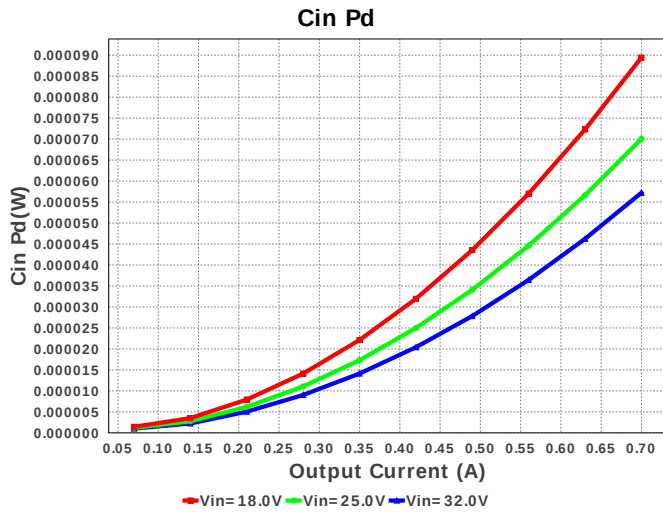


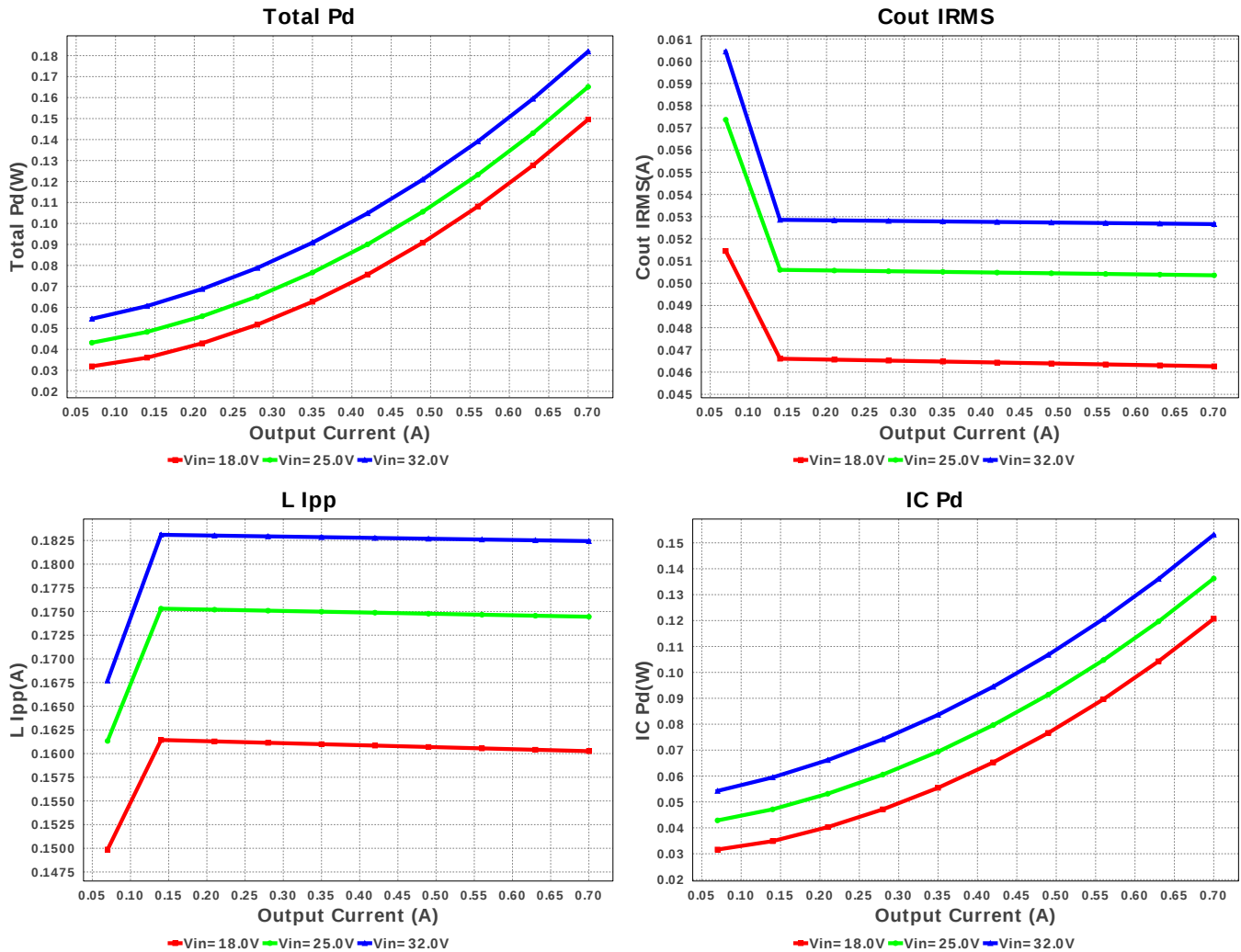
Vout Actual



Vout p-p







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	239.205 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	52.665 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	791.218 mA	Current	Peak switch current in IC
4.	Iin Avg	97.561 mA	Current	Average input current
5.	L Ipp	182.44 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	275.335 mA	Current	MOSFET RMS current
7.	BOM Count	14	General	Total Design BOM count
8.	FootPrint	980.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	90.498 kHz	General	Switching frequency
10.	IC Tolerance	16.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	126.0 mV	General	Voltage drop across the MosFET
12.	Mode	CCM	General	Conduction Mode
13.	Pout	2.94 W	General	Total output power
14.	Total BOM	\$3.37	General	Total BOM Cost
15.	Vout Actual	4.176 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	4.2 V	Op_Point	Operational Output Voltage
17.	Duty Cycle	13.5 %	Op_point	Duty cycle
18.	Efficiency	94.172 %	Op_point	Steady state efficiency
19.	IC Tj	37.655 degC	Op_point	IC junction temperature
20.	ICThetaJA	50.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	700.0 mA	Op_point	Iout operating point
22.	VIN_OP	32.0 V	Op_point	Vin operating point
23.	Vout p-p	891.2 μV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	57.219 μW	Power	Input capacitor power dissipation
25.	Cout Pd	13.549 μW	Power	Output capacitor power dissipation
26.	IC Pd	153.102 mW	Power	IC power dissipation
27.	L Pd	28.787 mW	Power	Inductor power dissipation
28.	Total Pd	181.947 mW	Power	Total Power Dissipation
29.	Vout Tolerance	3.666 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	700.0 m	Maximum Output Current
2.	VinMax	32.0	Maximum input voltage
3.	VinMin	18.0	Minimum input voltage
4.	Vout	4.2	Output Voltage
5.	base_pn	LMR24210	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. LMR24210 Product Folder : <http://www.ti.com/product/LMR24210> : contains the data sheet and other resources.

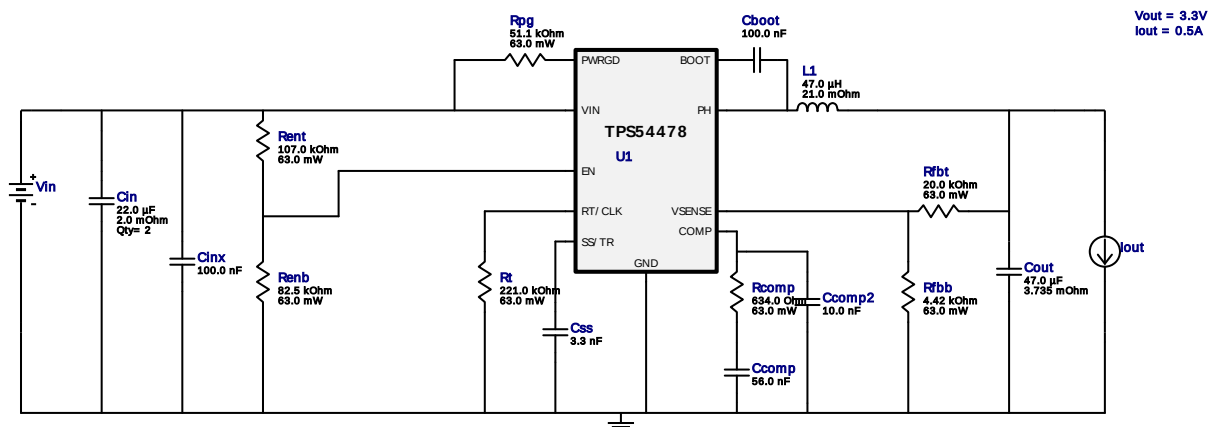


Vout = 3.3V
Iout = 0.5A

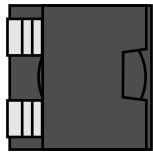
Device = TPS54478RTER
Topology = Buck
Created = 9/17/16 9:09:23 PM
BOM Cost = \$3.61
BOM Count = 17
Total Pd = 0.03W

WEBENCH® Design Report

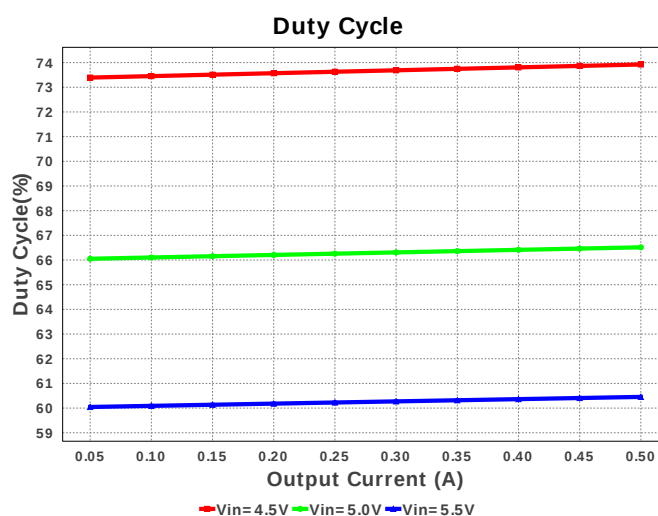
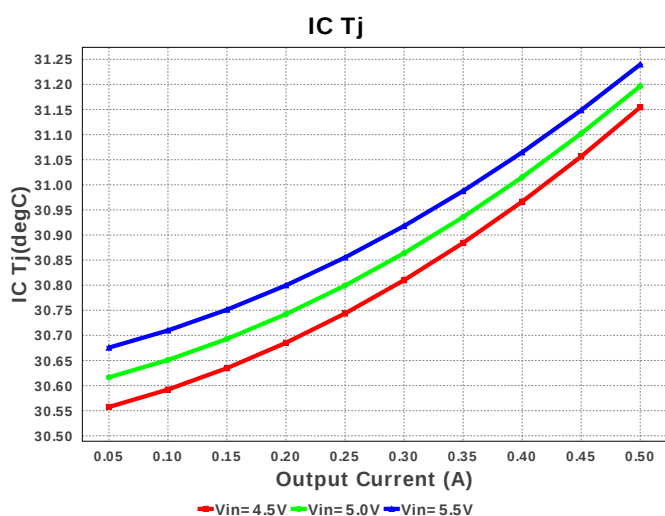
Design : 4790845/9 TPS54478RTER
TPS54478RTER 4.5V-5.5V to 3.30V @ 0.5A

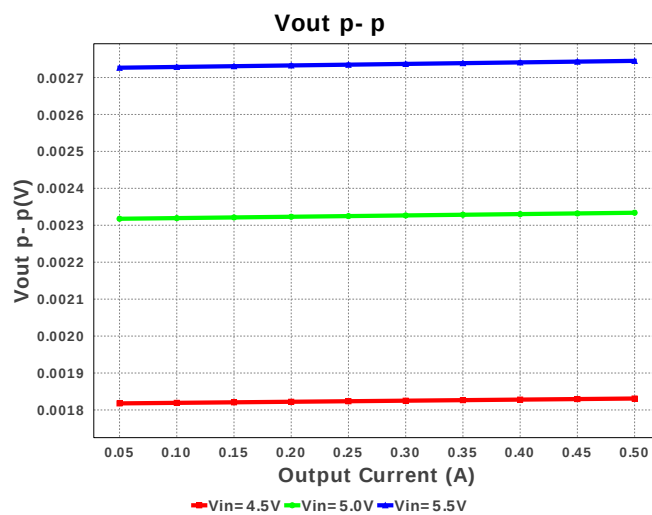
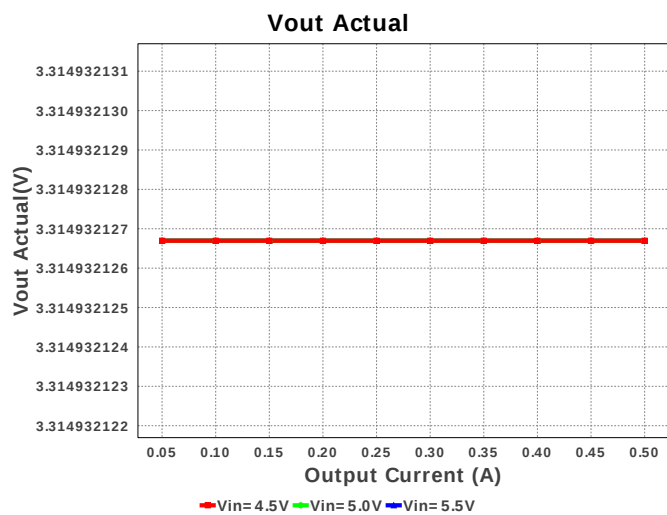
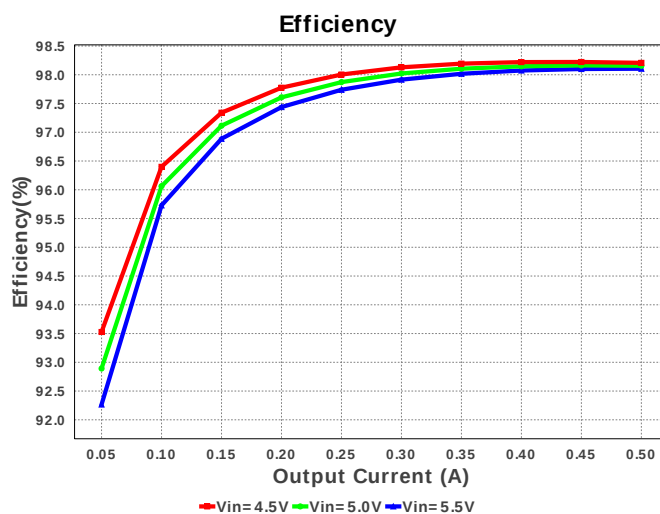
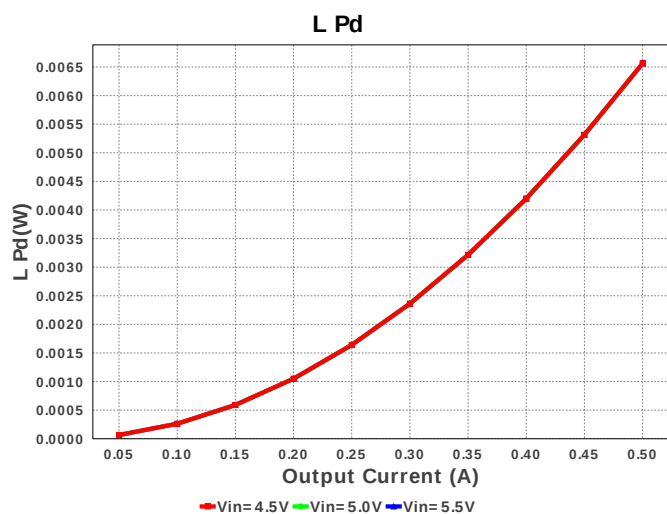
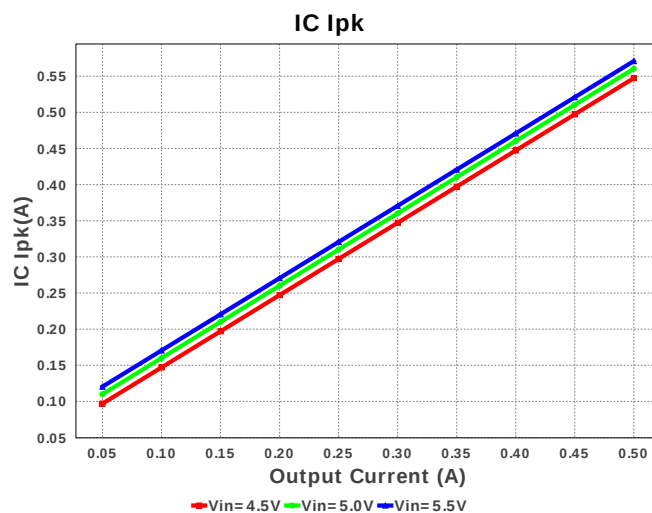
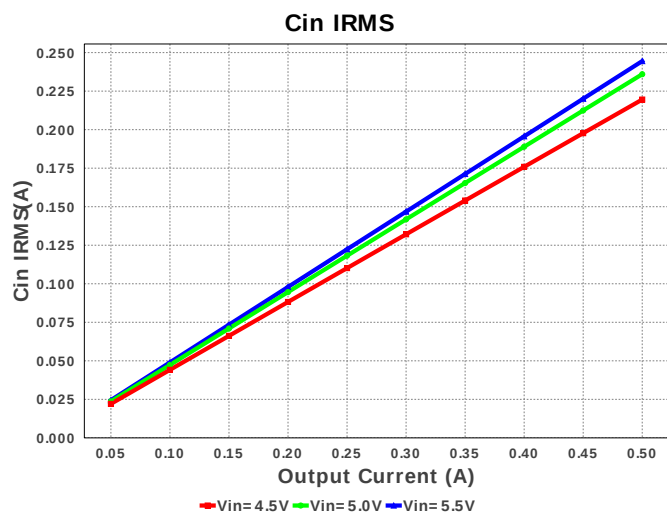


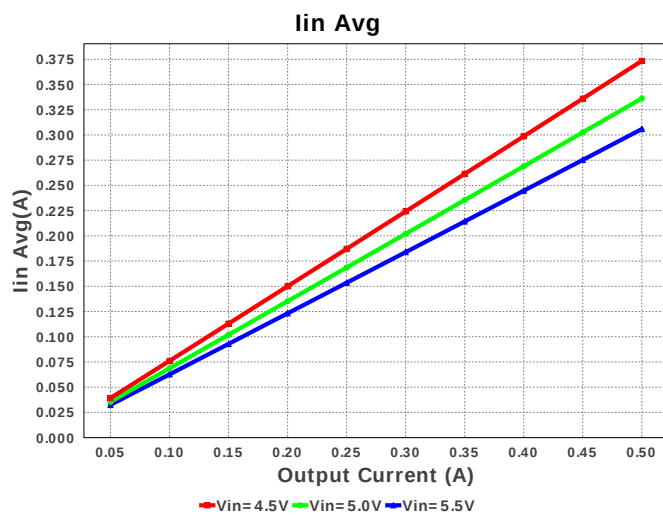
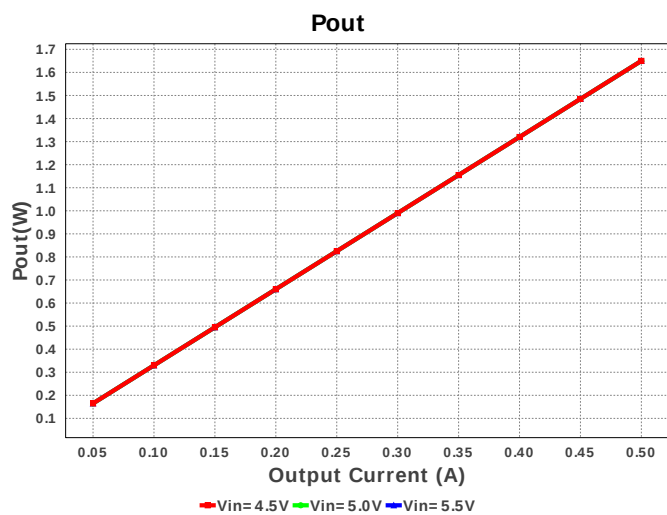
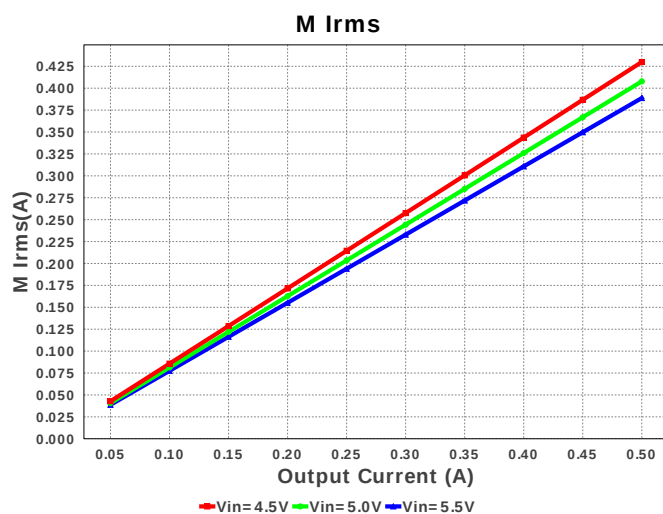
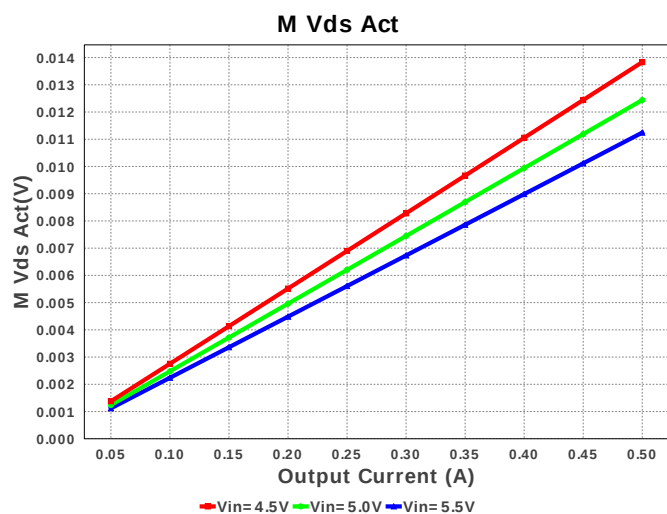
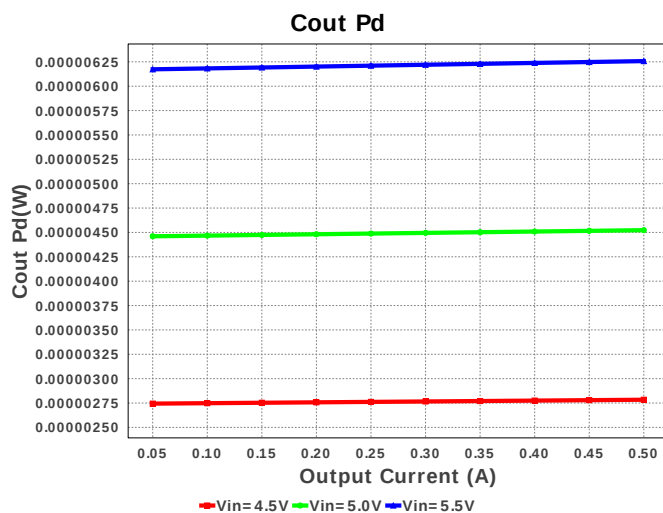
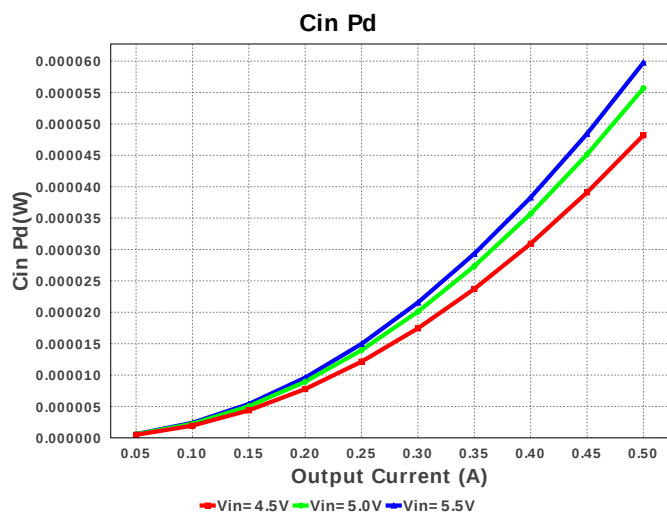
Electrical BOM

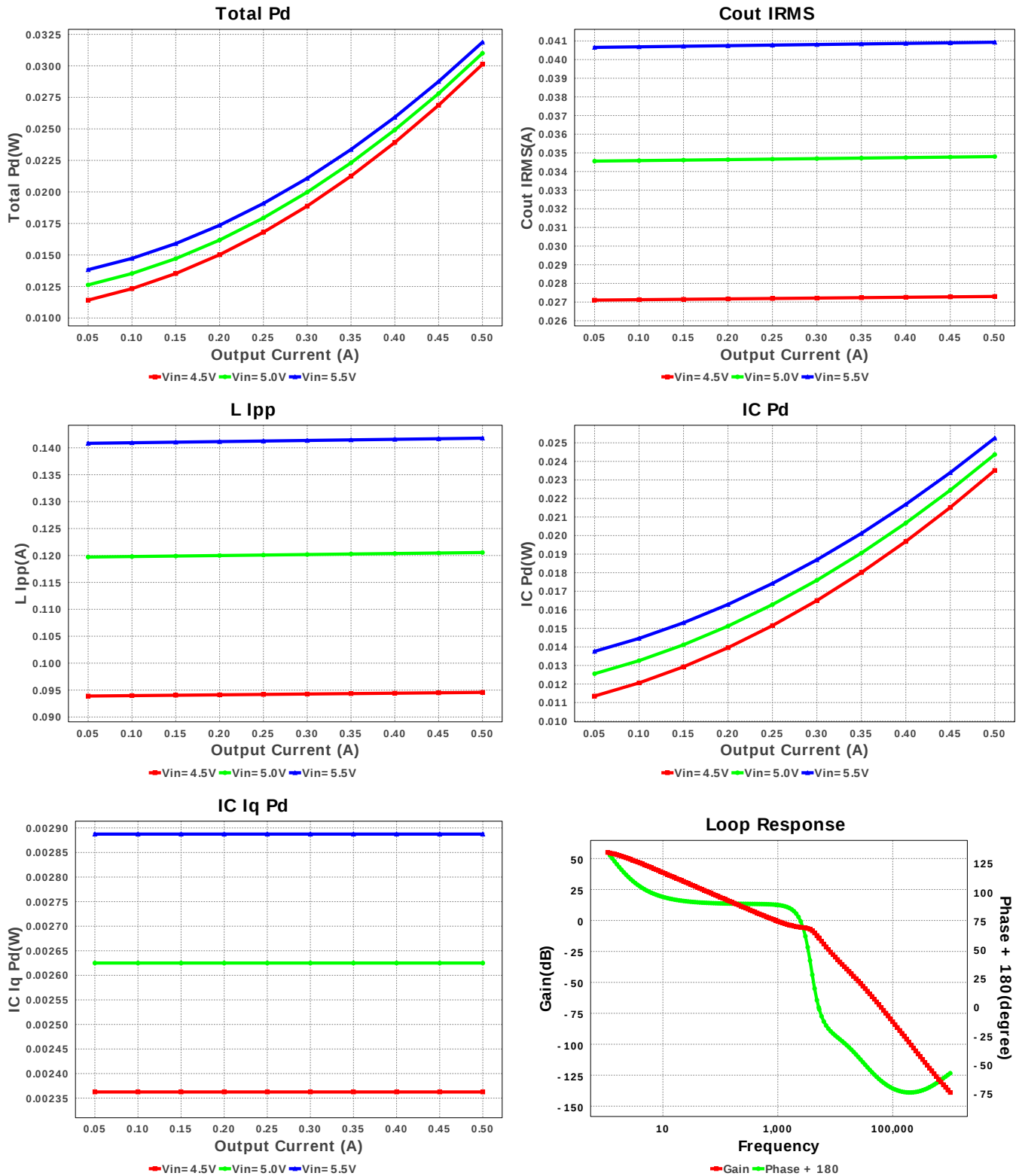
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R61C104KA88D Series= X5R	Cap= 100.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
2.	Ccomp	MuRata	GRM155R61A563KA01D Series= X5R	Cap= 56.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
3.	Ccomp2	MuRata	GRM033R60J103KA01D Series= X5R	Cap= 10.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
4.	Cin	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	2	\$0.12	1210 15 mm ²
5.	Cinx	MuRata	GRM155R61A104KA01D Series= X5R	Cap= 100.0 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
6.	Cout	MuRata	GRM31CC80J476KE18L Series= X6S	Cap= 47.0 uF ESR= 3.735 mOhm VDC= 6.3 V IRMS= 4.0522 A	1	\$0.10	1206_190 11 mm ²
7.	Css	MuRata	GRM033R61A332KA01D Series= X5R	Cap= 3.3 nF VDC= 10.0 V IRMS= 0.0 A	1	\$0.01	0201 2 mm ²
8.	L1	Coilcraft	SER1390-473MLB	L= 47.0 uH DCR= 21.0 mOhm	1	\$0.95	 SER1390 240 mm ²
9.	Rcomp	Vishay-Dale	CRCW0402634RFKED Series= CRCW..e3	Res= 634.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Renb	Vishay-Dale	CRCW040282K5FKED Series= CRCW..e3	Res= 82.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
11.	Rent	Vishay-Dale	CRCW0402107KFKED Series= CRCW..e3	Res= 107.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
12.	Rfbb	Vishay-Dale	CRCW04024K42FKED Series= CRCW..e3	Res= 4.42 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
13.	Rfbt	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
14.	Rpg	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
15.	Rt	Vishay-Dale	CRCW0402221KFKED Series= CRCW..e3	Res= 221.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
16.	U1	Texas Instruments	TPS54478RTER	Switcher	1	\$2.20	S-PWQFN-N16 17 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	244.475 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	40.931 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	570.895 mA	Current	Peak switch current in IC
4.	Iin Avg	305.8 mA	Current	Average input current
5.	L Ipp	141.79 mA	Current	Peak-to-peak inductor ripple current
6.	M Irms	388.76 mA	Current	MOSFET RMS current
7.	BOM Count	17	General	Total Design BOM count
8.	FootPrint	332.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	199.574 kHz	General	Switching frequency
10.	IC Tolerance	10.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	11.243 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Mode	CCM	General	Conduction Mode
13.	Pout	1.65 W	General	Total output power
14.	Total BOM	\$3.61	General	Total BOM Cost
15.	Vout Actual	3.315 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
16.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
17.	Cross Freq	923.678 Hz	Op_point	Bode plot crossover frequency
18.	Duty Cycle	60.454 %	Op_point	Duty cycle
19.	Efficiency	98.105 %	Op_point	Steady state efficiency
20.	Gain Marg	-14.011 dB	Op_point	Bode Plot Gain Margin
21.	IC Tj	31.24 degC	Op_point	IC junction temperature
22.	ICThetaJA	49.1 degC/W	Op_point	IC junction-to-ambient thermal resistance
23.	IOUT_OP	500.0 mA	Op_point	Iout operating point
24.	Phase Marg	89.451 deg	Op_point	Bode Plot Phase Margin
25.	VIN_OP	5.5 V	Op_point	Vin operating point
26.	Vout p-p	2.745 mV	Op_point	Peak-to-peak output ripple voltage
27.	Cin Pd	59.768 µW	Power	Input capacitor power dissipation
28.	Cout Pd	6.257 µW	Power	Output capacitor power dissipation
29.	IC Iq Pd	2.887 mW	Power	IC Iq Pd
30.	IC Pd	25.25 mW	Power	IC power dissipation
31.	L Pd	6.563 mW	Power	Inductor power dissipation
32.	Total Pd	31.872 mW	Power	Total Power Dissipation
33.	Vout Tolerance	3.349 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	500.0 m	Maximum Output Current
2.	VinMax	5.5	Maximum input voltage
3.	VinMin	4.5	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS54478	Texas Instruments Base Part Number
6.	source	DC	Input Source Type
7.	ta	30.0	Ambient temperature

Design Assistance

1. [TPS54478 Product Folder](http://www.ti.com/product/TPS54478) : <http://www.ti.com/product/TPS54478> : contains the data sheet and other resources.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

Use of Texas Instruments' WEBENCH simulation tools is subject to [Texas Instruments' Site Terms and Conditions of Use](#). Prototype boards based on WEBENCH created designs are provided AS IS without warranty of any kind for evaluation and testing purposes and are subject to the terms of the [Evaluation License Agreement](#).